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RACE REALITIES IN CULTURAL GUJARAT

REPORT ON THE ANTHROPOMETRIC, SEROLOGICAL AND HEALTH
SURVEY OF MAHA GUJARAT

By

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FOREWORD

When the Gujarat Research Society was founded in 1936, one of the earliest schemes of research contemplated was an anthropological survey of Gujarat. A few books mainly based on Census Reports and on materials collected for the District and Provincial and Central Gazeteers were in existence, and R. E. Enthoven's *Tribes and Castes of Bombay Presidency* (1922) held the field as a useful summary of anthropological data also for the Gujarat region.

In the *Journal of the Gujarat Research Society* for July 1939, I had made a review of the extant literature on the subject and pleaded for anthropometric research on nine subjects. I had suggested that the meagre data on which the anthropometric surveys of Sir Herbert Risley in 1897 and of Dr. B. S. Guha in 1931 were based should be supplemented by further research on a countrywide scale. There were difficulties in obtaining trained anthropometrists in Western India who would undertake this work on behalf of the Gujarat Research Society and nothing could be done till Dr. D. N. Majumdar volunteered as a labour of love to undertake in December, 1941, the anthropometric measurements of the Bhils of Panchmahals. Dr. G. M. Kurulkar of Seth G. S. Medical College, Bombay, also helped in this work. The results of their investigations were published in the *Journal of this Society* for October, 1942. The study was extended to the Bhils of the Rajpipla State in the winter of 1943 and Dr. Majumdar contributed a valuable paper in October 1944 number of the *Journal of this Society on the Racial Affiliation of the Bhils*. The further study of the problems of the Bhils has been entrusted to a research scholar Mr. T. B. Naik, to whom the Society gave a scholarship for about 3 years. He is now preparing a thesis for the Ph.D. degree on the Bhils. This important tribe, the total population of which is about 40 lakhs spread over various linguistic units exhibits a diversity of cultures and provides an ethnological problem of great complexity.

In the meantime, financial preparations were made by the Society to invite Dr. D. N. Majumdar for undertaking a racial, serological and a health survey of Maha Gujarat. With his indefatigable energy and his previous experience of similar surveys in the United Provinces and in Bengal, his tour extending over 2,000 miles of Gujarat, Saurashtra and Cutch in the winter of 1946, became extremely fruitful. He measured 3,600 persons and tested 3,000 blood samples belonging to 26 groups. This represents the most comprehensive survey attempted so far in this part of the country. A preliminary report under the title, '*Race Elements in Cultural Gujarat*,' was presented by Dr. Majumdar at the tenth anniversary celebrations of the Gujarat Research Society held in November, 1946.

The aspirations of the Gujarat Research Society for anthropological research are not restricted to the study of the culture of the exhibiting groups of tribes and castes and to the discussion of racial elements for the modern population of the country. It sponsored in 1941 with the help of the late Rao Bahadur K. N. Dixit,

Director General of Archaeology, an expedition for the study of the prehistoric man in the Sabarmati Valley under the leadership of one of its members, Dr. H.D. Sankalia. The first report of this survey appeared in the Journal of this Society for April 1943. The humble beginnings then made have blossomed forth in brilliant research subsequently financed by Sir Dorabji Tata Trust and the Deccan College Research Institute, and has laid the foundation of the modern study of the Prehistoric Man in Western India.

The composite character of anthropology, as a science covering as it does the study of man in all directions of his comprehensive activities including his health and physical fitness, has not been lost sight of by this Society. The present anthropometric survey conducted by Dr. Majumdar already includes a health survey. Further, the Health and Nutrition surveys of children and families conducted by this Society as also the standardisation of psychological and intelligence tests, form a part of the National Biometric Plan for the survey of the human material throughout India, contemplated by this Society, with special reference to Gujarat. Modern anthropology has extended its scope beyond the study of the tribal groups and is seeking to secure from anthropometry exact information about the physical and mental growth and development of the nation as a whole. Goldenweiser's classical study of the health of the population of New York City provides a valuable guide for similar research on a large scale in a backward country like India.

The present report of Dr. Majumdar's Survey of Cultural Gujarat presents several special features which are not only of regional but national and international importance:

1. The survey was planned after those for the United Provinces* and Bengal Province were completed and has the advantage of the previous experience both in the serological and anthropometric aspects, as well as the statistical analysis and representation.

2. The anthropometric measurements were all taken by one person, Dr. Majumdar himself and the serological tests were carried out under his personal supervision.

3. The physical measurements cover the standard 13 characteristics used by Guha in the Census Report, 1931, those for the U. P. and Bengal surveys by Dr. Majumdar and Dr. I. Karve for Maharashtra.

4. Cultural Gujarat is radically a homogeneous area. Whatever may have been the racial complexion of Gujarat in earlier days, today the various strains have got merged up and that is why Gujarat stands out as a meso-cephalic (medium-headed) province.

5. Though there are two dominant racial types in Cultural Gujarat, one brachycephalic (round-headed) and leptorrhine (narrow-nosed) and the other dolichocephalic (long-headed) and mesorrhine (medium-nosed), the latter resulting from a mixture with a dolichocephalic platyrrhine type, being the substratum, while between the two types are found a large number of mixed ones. Higher

* Published in *Saahitya*, Vol. IX, March 1949.

castes show more of brachycephally than the lower castes, the tribal groups being predominantly dolichocephalic.

6. The anthropometric results based on the reduced coefficient of racial likeness for the various measurements taken leads to a division of the twenty-four groups into four main clusters; (a) Bhangi, Bhil and others; (b) Koli, Artisans, Machhi and Kharwa; (c) Kunbi Patidar, Sunni Bora, Luhana, Memon, Khoja, Rajput, Nagar Brahmin, Audich Brahmin and Oswal Jain; (d) The Mehr, Rabari, Wagher and Miana; (e) The Parsi, Bhatia and Bhadela.

7. The serological evidence is almost similar to the above. The tribal groups, the Mehars, the Waghers and the Rabaris can be isolated from the higher castes and the Parsis.

8. So also the results of the health survey based on the surface area and basal metabolic rate point to a similar classification: (1) The Parsis, the Bhatia, the Bhadela and the Luhana come at the top; (2) the Audich Brahmin, Nagar Brahmin, Oswal Jain, Rajput and Kunbi Patidars occupy an intermediate status; (3) while Kolis, Machhis, the Artisans and the Bhangis are at the bottom.

Further statistical analysis by employing D^2 -statistic technique is being done at Lucknow and the results along with the individual data obtained for Gujarat, will be published in a subsequent number of this Journal.

Dr. D. N. Majumdar's anthropometric work in the region of Gujarat has been a labour of love to him. The U. P. and Bengal Anthropometric Surveys were planned under the auspices of the Provincial and Central governments and had larger resources available to them. When the Gujarat region was surveyed in 1946-47, the new Central State Ministry organisation was not even completed but the hospitality of the State authorities especially at Cutch, Porbandar and Rajpipla rendered the anthropometric and serological investigation possible within the short time available. The Government of Bombay very kindly gave a grant of Rs. 2,500 in the year 1946 for this research survey work, but the expenditure incurred has been very heavy. The Gujarat Research Society takes the opportunity to thank Dr. D. N. Majumdar and his collaborators for their methodical work and the State and Government authorities for their goodwill and co-operation which rendered possible this survey.

The Gujarat Research Society hopes that the work of anthropometric research thus initiated by it will be extended by the new Universities in Gujarat with new full fledged Departments of Anthropology. For without the study of man, all higher learning and research will lack the intimate contact with human realities which is the essential condition of human progress, and without such research, the new social order described in the new Constitution of India cannot be achieved.

P. G. SHAH,
Vice-President,
Gujarat Research Society.

10-11-1949, }
Bombay. }

INTRODUCTION

Huxley⁽¹⁾ compared India, her shape to the diamond on a pack of cards, having a north angle at Ladhak, a south angle at Cape Comorin, a west angle near the mouth of the Indus and an east angle near that of the Ganges. Herbert Risley⁽²⁾ described India as an irregularly triangular or pear shaped fortress, protected on two sides by sea and guarded on the third by the great bulwark of mountain ranges of which the Himalaya 'forms the central and most impregnable portion'. The natural defence of India, provided by the range of hills and the high seas, does not fit in with the chain of contacts India has had with the outside world, either through the successive invasions by land and sea or with the trade relations that India established with the middle and the Far East. In the nature of the country or in its climate from Central Asia to the Deccan, there seems to be no insuperable physical obstruction 'to the gradual migration of hordes of pastoral people alike for their food habits accustomed to rapid travel and nomadism'. Therefore, Risley's conception of India having been inhabited entirely by barbarous tribes until the Aryan invasion of c.1500 B. C. does not seem convincing.

Indian prehistory cannot be dissociated from that of Asia or of the Far East. The geographical characters of Asia, the possible division of Asia into two parts, the lowlands of Mesopotamia, India, China and Manchuria, must have had something to do with the dispersion of races of man. Two-fifths of Asia are occupied by two large plateaus, these are areas where no settled life is possible, they are either steppes or deserts; 'even the lowlands of Siberia are partly made up of marshy forests which prevented settlements.' Kropotkin,⁽³⁾ thinks that the most suitable cradle of civilisation must have been Mesopotamia. Haddon^(3A) suggested that man might have evolved somewhere in Southern Asia and he also thought it probable that the early groups were not unlike one another, but possessed a 'tendency to variability' which was controlled and directed by geographical fixation or isolation.

In spite of the generally conceded connection of India with the outside world from very early times, India's topographical conditions may have had some directive control on immigration. Before the introduction of navigation, India could probably be approached only through the chains of mountains, through the gaps and passes that outlined difficult routes. As most of the palaeolithic finds are located in the central and peninsular parts of the country, it is likely that the forests and the terrain referred to above, did not favour in the past any immigration of considerable importance or of continuous type. The palaeolithic age in India probably was not so well developed either in the perfection of the technique or in the forms of the implements, as one meets in Western Europe, during the middle or the upper

(1) J. Ethnological Society (Lond.), Vol. 1; (2) Risley, H. H., *People of India* (Lond.), 1915, p. 1; (3) *Geog. Journ.*, xxiii, 1904, pp. 176, 331; (3A) Haddon, A.C., *The Wanderings of Peoples*, p. 12, 15.

palaeolithic and as Col. Meadows Taylor (4) has said, 'the neolithic may even have superseded the lower palaeolithic.'

In a paper on the 'Neolithic' Problem in the Prehistory of India, Gordon R. Walley (5) gives an exposition of the distribution and nature of Indian Stone Culture, based on his archaeological field work in India during 1938-39, and also upon a bibliography of over 150 titles 'dealing specifically with neolithic-like objects found in India and also on the basis of literature dealing with the archaeology of the Middle East and the Far East. Walley concludes that 'there is no positive archaeological proof for the existence of neolithic peoples at any time before or after the use of metal was introduced into that country,' 'The Indian smoothed celts of neolithic' type appear to be derived from the eastward and there are typological relationships between the Indian and Far Eastern types. Also, as the south east Asian stone celts similar to Indian ones occur in archaeological associations with genuine stone age characteristics, most Indian celts also belong to the stone age cultures, and finally he assumes an eastern origin of a post-pleistocene prehistoric cultures, and as the neolithic sites are all located in eastern half of India, the latter belonged to a 'fairly large south and east Asiatic area.' Walley distinguishes the neolithic culture from the generally accepted classification with stone age cultures, for he says, 'the primary trait that sets neolithic culture apart from other stone age ones is that of intentional food-producing as opposed to mere food gathering as a means of subsistence. This trait is found in the form of agriculture or animal husbandry or a combination of the two; pottery is needed for storage, and that is why, it is associated with the neolithic culture, but pottery by itself cannot place a culture as neolithic. The distribution of the neolithic celts indicate a spread from the east to west while the indigenous stone cultures may or may not be associated with the neolithic.

River terraces in India have yielded a large variety of stone tools and implements which can probably be equated with similar artefacts in Europe and Africa. The mesolithic industries of Europe and Africa find their counterparts in the microlithic industries though the chronology and sequence of these industries are not certain. Microliths have a very wide distribution in India. In the Mahadeo Hills in C. P., all along the south-east coast, in Hyderabad State, in Mysore, central India and in cultural Gujarat, even as far as Sind and the Punjab various sites show not only the abundance of microliths, but significant details which enable a tentative approach to the dating of this culture. The Gujarat microlithic culture according to Sankalia is earlier than that of Mohenjo-daro while the association of microliths with neoliths in comparatively higher levels and the occurrence of microliths alone in the lowest levels in Mysore raise the problem of sequence as also of continuity of origins. From the stratigraphical evidence as far as it can be judged, it may be stated that no tools of human origins have been found in the early pleistocene beds but the various stone and flake industries can be tentatively traced to the middle and the upper pleistocene strata. Prehistoric research in recent years has outlined two 'different manufacturing traditions of similar antiquity one along the Indus and the Sohan terrace and the other from 'the basal Narabada Group of Central India,' and generally,

(4) Megalithic Tombs and Other Ancient Remains, Hyderabad, 1941.

(5) Walley, G. R., J., Washington Aca. Sc., Vol. 39, No. 6, June 15, 1949, pp. 181-201.

from the 'basal gravels all over India.' The Sohan industry with its primary focus in the north, produced pebble choppers and flakes and cores of clacto-lavalloisean types, and evolved on its own lines. (5A) The latter tradition is the core-tool or the hand-axe with its primary focus in the Peninsular portion, especially round Madras, and is related to the European or African *coup-de-poing* industry. From the chronology worked out on the basis of the glacial section in the Kashmir region, the late palaeolithic which is dominantly a flake industry of a 'full blooded lavalloisean similarly noticed in the Narbada valley and in Peninsular India' may be traced to the last glacial phase. It should not strike strange, if we focus the habitat of palaeolithic man in Peninsular India, the oldest finds of stone implements having been met in the lower Central Provinces, in the Godavari bed and in Hyderabad-Mysore and the ravine beds of the Madras Presidency. If neolithic spread from the east, palaeolithic might have had a southern origin. The proto-neolithic phase have been discovered in northern and western India but the microlithic phase is found widely scattered south of the Vindhya, though outposts are met with in the north (5B).

The skeletal remains of India are meagre and of doubtful antiquity. The Bayana and the Sialkot crania (6) cannot claim a distinct racial origin from the people of the Punjab as they are found today. The shape and size, of the two crania, are such as are obtainable among the people of the Punjab and on the evidence of the nasal bones in the Bayana skull, Keith takes it to be 'narrow prominent Aryan type.' The Nal bones, do not give a different origin, though Sewell and Guha find clear evidence of distinct races inhabiting parts of India and the region to the north and west. 'Of the three primitive skulls obtained from north western India,' write Sewell and Guha (7) "namely the Bayana, Sialkot and Nal Crania the last two show close affinities with each other, and almost certainly belong to a single race and are approximately representative of Mediterranean stock." The low vault of the Bayana skull and its height-bregma index are interpreted by the same authors, as indicating a certain degree of intermixture of the Mediterranean with certain other type.

The race elements in the population of the Indus valley at the time of Mohenjodaro and Harappa consisted probably of 'a longheaded, medium statured people,' not very powerful or strong, 'a tall longheaded heavy brained stout browed element' and a 'brachycephalic plano-occipital Armenoid type' which characterises the people of Asia Minor today. Dr. Krogman of the Boston Museum of Fine Arts U. S. A., examined a skull from Chanhodaro which is alleged to be that of a young woman placed in a jar after decapitation. He discovered a proto-Mediterranean strain in it with the ancestral Negro traits associated with it. Incidentally Krogman suggests that the Mediterranean race may have had a Negro infusion. Keith finds in one racial type of Mohenjodaro which showed a cephalic index of 70.5, a high vault, prominent brow ridge, a deep sub-glabellar notch and big post-auricular occipital development, Sumerian and Caucasian affinity, but some would affiliate it

(5A) Sankalia H. D. Investigations into the Prehistoric Archaeology of Gujarat, Baroda, (1946), pp., 101-132.

(5B) Krishnaswami, V.D., Stone Age India, Ancient India, No. 3, Jan., '47, p. 11.

(6) Keith, Sir Arthur JI. of Anth. Soc., Bombay, Vol. IX, No. 6, pp. 663.

(7) Memoirs of the Archaeological Survey of India, No. 35, 1925, p. 80.

with the Indo-Australoids. We have not much definite information to go by of the skeletal material of Mohenjo-daro or of Harappa, and neither we know the inter-relation between the Harappa and Mohenjo-daru racial types. The extensive distribution of the Harappa civilisation as evidenced from no less than thirty seven sites scattered over a thousand miles area make it probable that the massively fortified cities were probably autocratically ruled and were the seats of distinct racial or cultural groups monarchically disposed. (8) Whether the cultures of the three racial types were different and superimposed one upon the other we do not know but the destruction of the Harappa civilisation must have been brought about by the ravages of climate or by raids from the border countries. Some are strongly inclined to the view that the raiders came from Baluchistan 'which was probably, as it was up to a hundred years ago, the home of turbulent and warlike tribes.' Pathan raiders have a traditional past and their destructive role is too well-known in recent times to warrant refutation on slender evidence. The violent death to which the people of Mohenjo-daro is believed to have been subject to, as evident from 'the contorted attitudes in which the skeletal remains were discovered' has more than a passing interest. From an excavation in the upper loessic deposits near Nausheera in the Punjab Salt Range, De Terra found "stray microliths and remains of *Homo sapiens* of dolichocephalic type and funerary pottery of hand made neolithic type." In the Adichanallur skulls, Elliot Smith found a definitely Australoid and also an Armenoid strain at least among some of 'the better preserved specimens.' The racial type disclosed in the human remains at Taxilla is also longheaded with a low cranial vault and larger head which makes for brachycephaly. The face is 'unusually long and the nose fine and highly pitched.' Of the six skulls excavated in earthen urns in the Tinnevalley district of south India (1900) Zuckerman (1930) found one to be Australoid, but not of the most primitive character, the other he described as Mediterranean. The skulls discovered in Maski in Hyderabad, a preliminary examination of which was made by the author in 1948, (Report now in the Press) show two distinct racial types, a brachycephalic Armenoid type and a Mediterranean similar to the Sakkara series.

The race elements in Asia can be viewed in the background of craniological material, both proto-historic and prehistoric. There must have been more than one race of man in the palaeolithic times. Asia must have had several longheaded types which differentiated into distinct races in neolithic times. The distribution of the longheaded proto-nordic(?) and Mediterraneans who might originally have come from the same prehistoric ancestral racial stock, showed eastward and westward swings following the fluctuations of climate in Euro-Asia. The Turki and Ugrian, were the two brachycephalic peoples in Western Asia who had probably common origin. The Mongoloid peoples according to A. C. Haddon,(9) existed around the Central Plateaus and might have differentiated into two types and dispersed east and south. Movements of people from south China has influenced the East Archipelago. South of the Asiatic plateaus there probably lived a dark long headed race which scattered itself in south east Asia as far as south India. The Andaman Islanders, the Semang, the Aeta of the Philipines and the Pygmies of New Guinea are of Negrito Stock.

(8) Wheeler, R. E. M., Harappa, The Defences and Cemetery, Ancient India, No. 3, p. 60.

(9) Haddon, A. C., *Op. Cit.*, p. 32.

The earliest inhabitants of Sumer and Arabia were of the Mediterranean race and the Alpine race or the Western brachycephals had its centre of differentiation somewhere in western Asia. 'North-west of the hypothetical centre of origin of the human race, live the Nordics who may have been the latest to differentiate' and the adventurous spirit of the race made it possible for it to travel wide and scatter themselves over large areas in the proto-historic age. Coming towards India, Asia Minor had an Alpine substratum which probably mixed with a Mediterranean element and towards the west had an infusion of Scythian blood. The Semites have been in occupation of Syria from very early times and the greater part of Iran was 'originally inhabited by the Alpines, who are represented by the Tajiks.' 'The Persians are generally known to be proto-Nordics but they also show strong Mediterranean influence,' for which they have earned the title 'Oriental.' According to Deniker, the Iranians possessed the main characteristics of the Assyroid race with admixture of Turkish elements in Persia and Turkey, Indo-Afghan elements in Afghanistan and Arab and Negroid elements in the south of Persia and Baluchistan. The Persians have been divided by Deniker into three geographical groups, viz., the Tajiks, the Hajemis and the Parsis. The Tajiks spread beyond the frontiers of Persia into Western Afghanistan, the north west of Baluchistan as far as the Pamirs, even beyond. They are a brachycephalic people, above the average height and show traces of intermixture with the Turkish race. The Hajemis and in some measures the Parsis who are dolichocephalic and of average height are of Indo-Afghan type. The Parsis must have come into India after the destruction of the Sassanide empire according to Haddon. ⁽¹⁰⁾

Long before the Aryan speaking races came into India the country was inhabited by a dark race who is often confused with the Negrito but it was probably of the Indo-Australoid stock. 'Curious and interesting as they are from the point of view of general anthropology' wrote Herbert Risley⁽¹¹⁾ 'the Andamanese have had no share in the making of Indian people'. The anthropometric data collected by major Molesworth, led him to conclude that the Andamanese on anthropometric evidence were different from the aboriginal tribes of India and Sir William Flower and Sir William Turner came to the self-same conclusion. On the strength of craniometric evidence both Flower and Turner agree that the Andamanese heads differ in essential particulars from those of the Dravidians and the latter considers that 'no direct evidence of either a past or a present Negrito population in India has yet been obtained (Ibid p.32). The Andamanese are short headed, broad nosed, with a low cranial capacity which when compared with the Indo-Australoid indicate divergence of great significance. In a recent book on Human Ancestry, R. R. Gates traces the Indo-Australoids (Proto-Australoids) to the Pithecanthropus and about the origin of the Negrito, he thinks the latter probably originated later than the proto-Australoids. At any rate, writes Gates,⁽¹²⁾ their spread appears to have been at a later date. It is also suggested that the B blood-group has spread much later than O or A. The Indo-Australoids are low in B, but high in O and A, while as we pass into the Mediterranean and mixed Mediterraneans or the Alpine element in India

(10) Haddon, A. C., *Op. Cit.*, p. 26.

(11) Risley, H. H., *Op. Cit.*, p. 32.

(12) Gates, R. R., *Human Ancestry*, p. 355.

the incidence of B becomes high and decidedly significant. The Paniyans have a very high A and little B,⁽¹³⁾ and the Bhils have different values for B in different areas—the majority of Bhils do not show a high B incidence.⁽¹⁴⁾ The large incidence of B in India has been suggested to be due to Negrito mixture among the Mongoloids which later on filtered among the population of India as a whole, but the Chwan Miao in Western China have a very high B percentage. If a high B in India shows negrito mixture the serological evidence must be interpreted as assigning a negrito origin for the Jats, Pathans, Bengal and U. P. Brahmins and most of the high castes in India.⁽¹⁵⁾ The fact is that if there is a negroid influence in the Indo-Australoids, the latter is to be traced to the west and it is probably African, rather than that of the Negrito of the Far East. The Nishada which R. P. Chanda⁽¹⁶⁾ claimed to be represented by the dark, short statured and broadnosed jungle tribes of India are the 'Pre-Dravidians' of A. C. Haddon and were Indo-Australoids. The Nishadas, according to Chanda were the original speakers of the Munda family of languages, their descendants through contacts adopted either the Indo-Aryan or the Dravidian dialects or patois. Dr. S. Konow has found similarities of the Munda with Monkhmer and Pater Schmidt finds common elements between Munda, Khasi, Nicobarese, Wa, Sakai and the Monkhmer. That the Munda family of languages had a much wider distribution has also been suggested by E. A. Gait and S. C. Roy.⁽¹⁷⁾ The earliest inhabitants of India were probably the Indo-Australoids. The religious life of the Harappa people was characterised by various doses of plant and animal worship, and they were used to charms and amulets as well. They worshipped stones, phallic emblems, animals, half-human, fabulous and grotesque, also they worshipped tree spirits and other godlings. The figure of a man seated on a low stool with head gear made of buffalo horns fitted with plumes like the one worn by the Bison Horn Marias of Bastar, C. P., probably forming the ceremonial or dance dress of the peoples, surrounded by animals, point to non-Aryan influence in Mohenjodaro civilisation, for the buffalo is connected with the Monkhmer culture.

The tribal people of interior and frontier India (excluding the North Western Frontier which is now in West Pakistan) are either Indo-Australoid or Mongoloid. The Indo-Australoids have mixed with a Mediterranean Stock in Peninsular India and in Gujarat has been assimilated by a mixed Alpino-Mediterranean people, the Alpinoid more evident among the higher castes, the Mediterranean among the lower order of the caste structure, the Indo-Australoids providing a *jus connubii* of the immigrants, both of the Alpine and Mediterranean elements. It is this fact which makes for mesocephaly in cultural Gujarat. The foreign elements that have entered Gujarat both in the prehistoric and the protohistoric periods, are represented by the Mehr, the Kathi, the Bhadela, the Parsis and others and the Miana who have preserved their identity even today. The brachycephalic Alpine element, forms a top dressing on a Mediterranean base, though the Indo-Australoid substratum expresses itself in no uncertain way in the tribal and semi-tribal elements of Gujarat population.

(13) Aiyappan, A., Blood Groups of the Pre-Dravidians of the Wynaad Plateau, Current Sc. 4:493.

(14) Majumdar, D. N., The Bhils of Gujarat, J. Gujarat R. Soc., Vol. IV, No. 3, pp. 236.

(15) Malone and Lahiri, The Distribution of Blood Groups in certain Races and Castes in India, Ind. J. Med. R., 16, 863-868.

(16) Chanda, R. P., Indo-Aryan Races, Vol. 1, pp. 65-70.

(17) S. C. Roy, Mundas and Their Country, Introduction.

Guha⁽¹⁸⁾ measured 105 Nagar Brahmins, 99 Bania-Jain, 93 Audich Brahmins, 40 Kathis and 31 Brahma Kshatri, a total of 368 adult males (?). There is no mention of age and the localities he visited, or of the sampling technique. Writes Guha, 'In Kathiwar and Gujarat, measurements were taken on all the principal ethnic groups.' On the basis of coefficient of racial likeness (reduced), Guha finds intimate relationship between the Nagar Brahmin and the Bania-Jain ($C. R. L., 1.10 \pm 0.17$). Relationship between the Audich Brahmin and the Bania-Jain, the Nagar and the Kathi, the Kathi and Brahma Kshatri, is very close, says Guha. There are definite associations between the Nagar and the Audich Brahmin, the Nagar and the Brahma-Kshatri and the Kathi and the Bania-Jain. Finally associations are also found between the Audich Brahmin and the Brahma-Kshatri, and between the Audich Brahmin and the Kunbi-Pattidar and the Kathi. The Kunbi Pattidar however do not show any association with any other caste. The $C. R. L.$ between Kunbi Pattidar and the Kathi according to Guha's data is 15.73, between Kunbi Pattidar and the Brahma-Kshatri 24.51 between the Nagar and Kunbi Pattidar 20.41, between Kunbi Pattidar and the Bania-Jain, 14.31, and between Kunbi Pattidar and Audich Brahmin, it is 10.69. Guha quotes C. S. Venkatachar, I. C. S., and writes that the Kunbi migrated to southern Malwa as a result of the pressure from the Rajput tribes and it is possible that this agricultural community had belonged originally to a different racial substratum. The cephalic indices of the castes examined by Guha are as follow: Nagar Brahmins, 81.38 ± 0.26 , Bania-Jain 80.58 ± 0.29 , Audich Brahmins 78.77 ± 0.24 , Kathi 80.71 ± 0.47 , Brahma Kshatri 79.70 ± 0.44 . The Nagars have a nasal index 69.05 ± 0.44 , Bania-Jain 70.26 ± 0.44 , Audich Brahmins 69.90 ± 0.62 , the Kathi 71.11 ± 1.19 and Brahma Kshatri, 65.84 ± 0.6 . We did not find the indicial data from the Kunbi Pattidar, neither there are any individual data published from which these could be worked out. It is indeed pity that such a significant conclusion about the Kunbi Pattidar, who are an important rural community and forms the base of the caste structure in the province, should be without relevant data. The race elements in India have been worked out on anthropometric grounds, and yet there is no possibility of checking the conclusions, because the data do not exist. Risley, Crooke, and others have printed the anthropometric data on which their interpretations were based, and we know the value and the defects of such data, on the strength of which, the theories have been discarded by Guha himself. In any case, Guha finds Gujarat a brachycephalic cultural province, but he has completely ignored the lower castes, the Kolis, the Bhils, the Meghwars, the Dublas, and other artisan castes, high and low who are dolichocephalic or meso. The same remarks are true about the population of Bengal, where also there is a top dressing of Alpines on a sound Mediterranean and Australoid base. The brachycephaly among the higher castes may be Alpine in origin, the mesocephalic, in the lower castes is probably of Mongolian origin (Anthropometry and Crime, Man in India Vol. 29, 1, 1949). The Parsi, the Bhatia, the Miana, the Bhadela, the Rabari have a cephalic index ranging from 80 to 83, while the rest have a range from 76 of the Bhils, to 79.9 of the Sunni Bora. A comparison of the indices

(18) Census Report of India, Vol. 1, pt. 3 (1935) p. xxvi.

calculated by Guha with those presented in these papers, will make it clear that the Kunbi Pattidar does not represent a separate race in Gujarat and whatever the academic interpretation of their migrations may be, there is nothing in the anthropometric data to claim a separate origin for the Kunbi. The Kunbi have similar value for cephalic index to that of the Audich Brahmin, the Mehr, the Rajput, the Luhana, the Memon, the Khoja, the Nagar Brahmin, the Oswal Jain, and the Waghar. In nasal index, the Kunbi show resemblance with the artisans and tribal groups, and if the shape of the nose should be the criterion of racial distinction, the Kunbi have a lower average than the high castes of Gujarat, but the brachycephaly or pronounced mesocephaly of the Kunbi, distinguish them from the Bhil and the artisans.

In any case, Gujarat presents a homogeneous population or one tending towards it, and a realignment of the boundaries of Maha Gujarat is likely to help to integrate races and cultures into a people with a past and an enlightened future. One fact transpires in the analysis of racial elements in India, and that is that the various cultural regions have assimilated different race elements in a way to obliterate distinctions based on superficial divergences in head form or in the shape of the nose, and what has been possible in a cultural area is equally indicative of the whole of this sub-continent, so that the future of Indian people is, not likely to be controlled by racial expansion but by integration of cultures which have been produced by different races working a common destiny. The untouchability in India and the backwardness of tribal cultures is a transitional phase, perpetuated in the interest of alien invaders or usurpers, and knowledge of race origins and of cultural parallelisms will help rather than retard reconstruction and integration.

In the report following we have detailed the racial and serological data and the results of statistical analysis. In a subsequent publication, we shall give the results of D^2 statistics, applied to the anthropometric data, also the individual data.

I am grateful to my pupils, Miss Esther Newton and Mr. Shankar Sahai Srivastava for the charts and diagrams prepared by them and printed along.

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Jan. 6, 1950.

D. N. MAJUMDAR

SEROLOGICAL STATUS OF CASTES AND TRIBES OF CULTURAL GUJARAT

By

D. N. MAJUMDAR AND K. KISHEN

At the invitation of the Gujarat Research Society in 1946, we undertook a racial and serological survey of Gujarat, Kathiawar and Cutch. The two previous racial surveys, one in the United Provinces carried out in 1941-43 under the auspices of the Provincial Census Operations, 1941, and financed by the Central Government, and the other in Bengal which was initiated and financed by the Indian Statistical Institute, Calcutta, completed by us in 1945, equipped us with the experience necessary for such large-scale surveys, the details of which were set out in the reports of these surveys both with regard to the technique of field investigations and the methods of statistical analysis of the serological and anthropometric data. The anthropometric data collected in the United Provinces were handed over to Prof. P. C. Mahalanobis, F.R.S., of the Statistical Laboratory, Calcutta, who with his colleague, Mr. C. R. Rao, analysed them at Calcutta and a summary of the results obtained from the statistical analysis was published in the Proceedings of the Indian Science Congress Association, Bangalore Session, 1946. Mahalanobis applied his Generalised Distance method in the final treatment of the anthropometric data and the results have been found to be very significant both with regard to the suitability of the statistical tool and the quality and reliability of the data. As this was the first occasion, at least in India, that a random sample survey was attempted with human material for racial studies, the results must be highly instructive and we found that the conclusions arrived at independently by the statistician and the anthropologist, the former by marshalling the anthropometric data and the latter by a study of definite and indefinite characters, agree in essentials, a fact which is likely to lead to greater collaboration between the two branches of science.

2. The Report of the U. P. Anthropometric Survey is being published with the individual measurements in Sankhya, the organ of the Indian Statistical Institute and will also be separately published in book form. [The serological data on the U. P. tribes and castes have been analysed at Lucknow and published in the Eastern Anthropologist, Vol. I, No. I (1947)]. The Bengal Survey of 1945 in which about 4,000 adults belonging to the various parts of the Province,—Hindus, Muslims and other minority communities,—were measured and a similar number of persons tested with regard to the blood-group frequencies among them, was the second large undertaking by us. Both the anthropometric and serological data are being analysed by Mahalanobis.

3. Regarding the sampling technique both in the U. P. and Bengal, we may quote the following passage from the Joint Report on the U. P. Racial Survey (1941-43) by Mahalanobis, Majumdar and Rao. Mahalanobis writes as follows : "The random selection of a sample is not always an easy task. To pick up a random sample in a demonstrably rigorous fashion requires very elaborate preliminary arrangements which are not often possible in practice. In this situation, rough and ready methods have to be used. The important point, however, is to exclude any personal bias on the part of the observer. In the present investigation, Dr. D. N. Majumdar went to each locality, collected all healthy adult males usually between the ages of 25 and 40 (belonging to the caste or tribe under survey) who happened to be available, arranged them in serial order, and picked up either the odd or even numbered individuals for measurement. The only restriction he used was to avoid examining more than one person belonging to the same family, but did not use any other principle of selection. Strictly speaking, exclusion of more than one individual belonging to the same family makes the sample theoretically somewhat different from an ideal random sample. In estimating mean values, the only effect would be that arising from the varying number of adult males in the different families ; such variation, however, must be small and almost certainly negligible. Variabilities in the present sample may also be slightly larger than those in the general population but this would make tests of significance err on the safe side. In any case there is no difficulty in making valid comparison among samples collected in the same way.

"To sum up, Dr. Majumdar was fully aware of the need of selecting the individuals at random, and he took particular care to eliminate all choice on his own part. The present samples may, therefore, be treated as having been drawn, for all practical purposes, at random. As far as one can judge, the assumption of randomness is more true of the present material than of any other series of anthropometric measurements so far available in India."

4. As the subjects who submitted to anthropometric tests were also required for blood grouping, it was not possible to get more than one person per family who would volunteer for the purpose, and blood groups being genic, the 'selection' if it could be proved, did help rather than prejudice our serological material. The same methods and techniques of investigation followed in the United Provinces and in Bengal were employed in Gujarat with local adjustments of minor nature where necessary, and therefore, the anthropometric and serological data collected during the three surveys are comparable. We made it certain that no change in our ideas of measurements or of technique took place during the period covering the time required for the three surveys though changes in the personnel of the laboratory staff had to be made, the casualties having been due to the demand for the assistants elsewhere including the Anthropological Survey of India. The anthropometric measurements were all taken by one person (in this case by Dr. Majumdar himself), the serological tests were done under his supervision and the results in every case compared between the assistants and the supervisor.

5. The serological technique followed in the Gujarat Survey was similar to that already described for the U. P. Survey, (*vide* Eastern Anthropologist, Vol. I, No. I, 1947, pp. 8-16). It conforms to the recommendations of the Blood Transfusion Research Committee of the Medical Research Council (Med. Res. Coun. War Mem. No. 9, 1944). The testing sera were supplied by the Haffkine Institute, Bombay and arranged for by the Gujarat Research Society. High titred sera with capacity to react with A_2 and A_2B cells were taken from Lucknow as and when required, the donors being at Lucknow. The active interest of the office bearers of the G. R. Society, particularly of Mr. P. G. Shah, and the generous response of the local authorities both in British India and in the States, helped to expedite the survey and we were able to complete the work in record time. The time factor was important in this case as we wanted to complete the work within a reasonably short period, due to the fact that the University of Lucknow sanctioned us duty leave for a month to be affixed to the long vacation of three months, and no further extension of leave was possible. Our movements were speeded where necessary by air travel. Although the distances travelled were considerable, the centres visited mostly rural, and the work done considerable in volume, it was possible to complete the survey because of the interest of the investigators in the work and thanks must be given to the assistants, particularly Mr. Sher Singh, Mr. S. Roy, and Mr. T. B. Naik. To the people of cultural Gujarat, we are grateful for both hospitality and enlightened interest in our research. The material and equipments for the Survey were loaned by the Lucknow University. The Gujarat Research Society paid a lump grant of Rs. 2,800/- towards the pay and remuneration of the staff and travelling and boarding expenses, Dr. Majumdar and T. B. Naik working in voluntary and honorary capacities. Thanks are also due to the Council of the Gujarat Research Society not merely for the financial assistance and active interest in the work, but also for the uniform courtesy shown to us and their anxiety to understand our points of view whenever any cause for determining initiative arose.

6. Twenty-two castes and tribes of cultural Gujarat including Kathiawar and Cutch were examined both with respect to their somatology and serology, and the social groups included in the Survey were reached at the centres of their concentration. The Bhils were examined in the Panchmahal district and in Rajpipla, also from the western Khandesh, the Macchhis from the Rajpipla State, the Satwaras from Ahmedabad, Billimora, Porbunder, Dwarka and Mithapur, the Kolis from Cutch and Ahmedabad, the Waghers from Porbunder, Dwarka and Mithapur, the Rabaris from Porbunder, Jamnagar and Cutch, the Kharwas from Porbunder, the Kunbi Pattidars from Rajpipla State, Billimora, Nawanagar State, Cutch and Ahmedabad, the Bhatias from Cutch, Nawanagar, Porbunder and Bombay, the Audich Brahmins from Nawanagar State, Cutch, Porbunder, Dwarka and Bombay, the Luhanas from Porbunder, Jamnagar and Cutch, some from Bombay, the Mehars from Porbunder, Nagar Brahmins from Cutch, Rajkot, Jamnagar and Bombay, Mianas from Cutch, Dwarka, Mithapur and other coastal areas of Kathiawar, the Sunni Borahs from Rajpipla, Ahmedabad, Cutch and Bombay, the Bhangis from Porbunder and Jamnagar, the Parsis from Billimora and Bombay, the Memons and the Khojas from Cutch, Porbunder, Jamnagar and Bombay, and the Miscellaneous Tribal

groups from the Ahmedabad cotton mills and Billimora. A detailed account of the parts visited will be given in Part Two which will contain the analysis of the anthropometric data. The extensiveness of the inquiry will be evident when it is known that we have measured about 3,000 people and tested 3,000 blood samples belonging to 26 groups in cultural Gujarat. We have only included in our analysis, castes and tribes from whom one hundred or more individuals could be tested, as a sample of less than 100 has not been considered adequate for the purpose.

STATISTICAL ANALYSIS OF THE BLOOD-GROUPS DATA

7. Below we are discussing the results of statistical analysis of the blood-groups data of 22 castes and tribes of Gujarat, Kathiawar and Cutch. The methods of statistical analysis adopted are precisely the same as those for the analysis of the blood-groups data of representative castes and tribes in the United Provinces. However, to make this paper self-contained, these methods have been briefly explained in the subsequent paragraph.

8. Let the true gene probabilities of the triple allelomorphic genes A, B, and O for a caste (or tribe) be denoted by π_1 , π_2 and π_3 respectively. Then $\pi_1 + \pi_2 + \pi_3 = 1$. The values of these population parameters are not known and can only be estimated from the observed frequencies of the four phenotypes for the sample taken from the caste (or tribe). It is well-known that the most efficient estimates of π_1 , π_2 and π_3 are provided by the method of maximum likelihood and reference may be made to Stevens (1) in this connexion. Bernstein has also given a method of obtaining efficient estimates of these parameters. The formulae for the variances and covariances of Bernstein's improved estimates have been worked out by Sukhatme (2). In our present investigation, we have throughout used estimates derived by the method of maximum likelihood and denoted the estimated probabilities of A, B, and O genes by p , q and r respectively.

9. The blood-groups data of the 22 castes and tribes collected during the Racial Survey of Gujarat, Kathiawar and Cutch are presented in Table 1. Column (2) of the Table gives the size of the observed samples for the various castes and tribes, and Columns (3), (4), (5) and (6), the observed frequencies of the four phenotypes O, A, B, AB. Using the maximum likelihood estimates of the true gene probabilities, the conformity of these blood-groups data with the genetical theory advanced by Bernstein [(3) and (4)] has been tested by applying the χ^2 test with one degree of freedom. The values of χ^2 for the various castes and tribes are shown in Column (7) and the corresponding levels of probability in Column (8). Here, as also in all the other tables, items significant at the 5 per cent level of probability are marked with a single asterisk, those significant at the 1 per cent level with two asterisks and those significant at the 0.1 per cent level with three asterisks. It would appear from this table that the value of χ^2 is not significant for any of the castes and tribes at the customary 5 per cent level of probability. Thus the blood-groups data for all the 22 castes and tribes are in good agreement with Bernstein's genetical theory.

10. The maximum likelihood estimates of the true gene probabilities for the 22 castes and tribes, along with their standard errors, are given in Table 2. Column (3) of this Table gives the estimated gene probabilities, Column (4) the corresponding variances and Column (5) the estimated gene probabilities and their standard errors, both multiplied by 100. The homogeneity of the estimated probabilities for A, B and O genes for these 22 castes and tribes is then tested by applying the χ^2 -test. In this case, $\chi^2=82.1252$ with 42 degrees of freedom. This gives $\sqrt{2\chi^2} - \sqrt{2n-1}=3.7060$ and leads to the conclusion that the gene probabilities are not all equal for the above 22 castes and tribes. In order to determine whether the homogeneity is attributable to the differences in one or more of the three gene probabilities, the χ^2 has been partitioned, first for differences in the estimated probabilities (p) of the A genes, then for differences in the estimated probabilities (q) of the B genes and finally for differences in the estimated probabilities (r) of the O genes, and the results are presented in Table 3. It would appear from this Table that the heterogeneity among the estimated gene probabilities is ascribable to the differences among all the three probabilities.

11. The heterogeneity among the estimated probabilities of A, B and O genes having been demonstrated to be attributable to the variation in the estimated probabilities p of A genes, q of B genes and r of O genes, we proceed to test the significance of the differences among the p's, q's and r's for the 22 castes and tribes. In Table 4 are given the differences among the estimated probabilities p of A genes. In this Table, the figure in each cell is the difference between the values of p for the two castes (or tribes) given at the top of the vertical column and the extreme left of the horizontal row containing the cell. Thus, for instance, the value of the difference, Rabaris—Satwaras, is 0.004679. In this Table, as also in Tables 5 and 6, significant positive differences have been marked with one, two or three asterisks according as these are significant at the 5 per cent level, 1% level or 0.1% level, respectively, the significance having been tested by finding out the ratio of each of these differences to its standard error and treating this ratio as a normal variate with zero mean and unit variance. It would appear from Table 4 that the value of p for Sunni Borahs is not significantly different from the p-values for Waghers, Luhanas, Kolis, Miscellaneous Tribal, Rajpipla Bhils, Parsis, Kharwas, Khojas, Memons, Audich Brahmins, Mianas and Satwaras, but is significantly lower than the p-values for Khandesh Bhils, Panchmahal Bhils, Kunbi Pattidars, Rabaris, Nagar Brahmins, Bhatias, Mehars, Bhangis and Macchis. The p-values for Waghers and Luhanas, the difference between which is not significant, are not significantly different from the p-values for Kolis, Miscellaneous Tribal, Rajpipla Bhils, Parsis, Kharwas, Khojas, Memons, Khandesh Bhils, Panchmahal Bhils, Audich Brahmins, Mianas, Satwaras, Kunbi Pattidars, Rabaris and Nagar Brahmins, but are significantly lower than the p-values for Bhatias, Mehars, Bhangis and Macchis. The p-values for Kolis, Miscellaneous Tribal, Rajpipla Bhils and Parsis, the differences among which are not significant, are not significantly different from the p-values for Kharwas, Khojas, Memons, Khandesh Bhils, Panchmahal Bhils, Audich Brahmins, Mianas, Satwaras, Kunbi Pattidars, Rabaris, Nagar Brahmins, Bhatias and Mehars, but are significantly lower than the p-values for Bhangis and Macchis. The p-values for Kharwas,

tal row containing the cell. It would appear from Table 5 that the value of q for Khandesh Bhils is not significantly different from the q -values for Mehrs, Nagar Brahmins, Panchmahal Bhils, Rajpipla Bhils, Macchis, Kharwas, Waghers, Bhatias and Rabaris, but is significantly lower than the q -values for Audich Brahmins, Miscellaneous Tribal, Kunbi Pattidars, Sunni Borahs, Parsis, Khojas, Kolis, Bhangis, Satwaras, Mianas, Luhanas and Memons. The q -values for Mehrs and Panchmahal Bhils, the difference between which is not significant, are not significantly different from the q -values for Nagar Brahmins, Rajpipla Bhils, Macchis, Kharwas, Waghers, Bhatias, Rabaris, Audich Brahmins, Miscellaneous Tribal and Kunbi Pattidars, but are significantly lower than the q -values for Sunni Borahs, Parsis, Khojas, Kolis, Bhangis, Satwaras, Mianas, Luhanas and Memons. The q -values for Nagar Brahmins is not significantly different from the q -values for Panchmahal Bhils, Rajpipla Bhils, Macchis, Kharwas, Waghers, Bhatias, Rabaris, Audich Brahmins, Miscellaneous Tribal, Kunbi Pattidars, Sunni Borahs and Kolis, but is significantly lower than the q -values for Parsis, Khojas, Bhangis, Satwaras, Mianas, Luhanas and Memons. The q -value for Rajpipla Bhils is not significantly different from the q -values for Macchis, Kharwas, Waghers, Bhatias, Rabaris, Audich Brahmins, Miscellaneous Tribal, Kunbi Pattidars, Sunni Borahs, Parsis, Khojas, Kolis and Bhangis, but is significantly lower than the q -values for Satwaras, Mianas, Luhanas and Memons. The q -value for Macchis is not significantly different from the q -values for Kharwas, Waghers, Bhatias, Rabaris, Audich Brahmins, Miscellaneous Tribal, Kunbi Pattidars, Sunni Borahs, Parsis, Khojas, Kolis, Bhangis, Satwaras, Mianas and Memons, but is significantly lower than the value of q for Luhanas. There are no significant differences among the q -values for Kharwas, Waghers, Bhatias, Rabaris, Audich Brahmins, Miscellaneous Tribal, Kunbi Pattidars, Sunni Borahs, Parsis, Khojas, Kolis, Bhangis, Satwaras, Mianas, Luhanas and Memons.

The above conclusions may be symbolically represented as follows :—

Khandesh Bhils	
Mehrs	
Nagar Brahmins	
Panchmahal Bhils	
Rajpipla Bhils	
Machhis	
Kharwas	
Waghers	
Bhatias	
Rabaris	
Audich Brahmins	
Miscellaneous Tribal	
Kunbi Patidars	
Sunni Borahs	
Parsis	
Khojas	
Kolis	
Bhangis	
Satwaras	
Mianas	
Luhanas	
Memons	

14. From the point of view, therefore, of homogeneity among the estimated probabilities of B genes, the 22 castes and tribes may be arranged in groups as under, the castes and tribes in each group having usually higher q-values than those in the preceding group :—

- (a) Khandesh Bhils;
- (b) Mehars and Panchmahal Bhils;
- (c) Nagar Brahmins;
- (d) Rajpipla Bhils ;
- (e) Macchhis; and
- (f) Kharwas, Waghers, Bhatias, Rabaris, Audich Brahmins, Miscellaneous Tribal, Kunbi Pattidars, Sunni Borahs, Parsis, Khojas, Kolis, Bhangis, Satwaras, Mianas, Luhanas and Memons.

15. We finally proceed to test the significance of the differences in the r's among the 22 castes and tribes. These differences are shown in Table 6, where, as before, the figure in each cell is the difference in the values of r for the two castes (or tribes) given at the top of the vertical column and the extreme left of the horizontal row containing the cell. It would appear from this Table that the value of r for Bhangis is not significantly different from the r-values for Macchhis, Satwaras, Mianas, Memons, Bhatias, Luhanas, Kunbi Pattidars, Khojas, Parsis, Audich Brahmins, Kolis and Rabaris, but is significantly lower than the r-values for Miscellaneous Tribal, Mehars, Nagar Brahmins, Kharwas, Sunni Borahs, Panchmahal Bhils, Rajpipla Bhils, Waghers and Khandesh Bhils. The r-value for Macchhis is not significantly different from the r-values for Satwaras, Mianas, Memons, Bhatias, Luhanas, Kunbi Pattidars, Khojas, Parsis, Audich Brahmins, Kolis, Rabaris, Miscellaneous Tribal, Mehars, Nagar Brahmins and Kharwas, but is significantly lower than the r-values for Sunni Borahs, Panchmahal Bhils, Rajpipla Bhils, Waghers and Khandesh Bhils. The r-values for Satwaras, Mianas and Memons, the differences among which are not significant, are not significantly different from the r-values for Bhatias, Luhanas, Kunbi Pattidars, Khojas, Parsis, Audich Brahmins, Kolis, Rabaris, Miscellaneous Tribal, Mehars, Nagar Brahmins, Kharwas and Sunni Borahs, but are significantly lower than the r-values for Panchmahal Bhils, Rajpipla Bhils, Waghers and Khandesh Bhils. The r-values for Bhatias, Luhanas, Kunbi Pattidars, Khojas and Parsis, the differences among which are not significant, are not significantly different from the r-values for Audich Brahmins, Kolis, Rabaris, Miscellaneous Tribal, Mehars, Nagar Brahmins, Kharwas, Sunni Borahs, Panchmahal Bhils, Rajpipla Bhils and Waghers, but are significantly lower than the value for r for Khandesh Bhils. There are no significant differences among the r-values for Audich Brahmins, Kolis, Rabaris, Miscellaneous Tribal, Mehars, Nagar Brahmins, Kharwas, Sunni Borahs, Panchmahal Bhils, Rajpipla Bhils, Waghers and Khandesh Bhils.

The symbolical representation of these conclusions is as follows :—

Bhangis	Macchhis	Satwaras	Mianas	Memons	Bhatias	Luhanas	Kunbi Pattidars	Khojas	Parsis	Audich Brahmins	Kolis	Rabaris	Miscellaneous Tribes	Mehrs	Nagar Brahmins	Kharwas	Sunni Borahs	Panchmahal Bhils	Rajpipla Bhils	Waghers	Khandesh Bhils
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16. It would appear from the above that from the standpoint of homogeneity among the estimated probabilities of O genes, the 22 castes and tribes may be arranged in the following groups, the castes and tribes in each group having higher r-values than those in the preceding group :—

- (a) Bhangis ;
- (b) Macchhis ;
- (c) Satwaras, Mianas and Memons ;
- (d) Bhatias, Luhanas, Kunbi Pattidars, Khojas and Parsis; and
- (e) Audich Brahmins, Kolis, Rabaris, Miscellaneous Tribal, Mehurs, Nagar Brahmins, Kharwas, Sunni Borahs, Panchmahal Bhils, Rajpipla Bhils, Waghers and Khandesh Bhils.

17. On account of the heterogeneity among the estimated gene probabilities for the 22 castes and tribes, the weighted means of p, q and r (the weights being the sizes of the observed samples) are not efficient estimates of the true gene probabilities. The weights which have, therefore, been used by us are reciprocals of the variances as these yield estimates of the mean values with the least variance. Denoting the mean values thus obtained by \bar{p} , \bar{q} and \bar{r} , we have

$$\bar{p} = 0.194949 \pm 0.00538609,$$

$$\bar{q} = 0.231587 \pm 0.00580431,$$

$$\bar{r} = 0.565531 \pm 0.00698427,$$

The corresponding percentages and their standard errors can be immediately obtained by multiplying each of these figures by 100.

18. The serological data for the tribes and castes of the United Provinces have indicated in a general way the racial distance of the various social groups as there is some correspondence between the order of social precedence of the groups with their p-values, the heterogeneity of the estimated probabilities of A, B and O genes having been found to be mainly attributable to the variation in the estimated pro-

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bilities (p) of A genes. The United Provinces does contain a mixed population and the degree of intermixture can be found out by comparing the samples with known hybrid castes or mixed population as in a College which caters for all provinces, castes, creeds and complexions. In cultural Gujarat, the various samples have proved to be heterogeneous with respect to all the three genes. The Bhils of different areas show serological differences among them and we had explained this elsewhere by suggesting that the Bhil is a generic name including different racial strains. The Kolis, Miscellaneous Tribal people and the sections of the Bhils we have examined should form a constellation if we accept the view usually put forward that the tribal groups have remained isolated due either to cultural backwardness or fear of the more organised and advanced social groups from whom they have received little consideration and more contempt. On the basis of their p-values, these groups may be said to form a constellation; and if we interpret the arrangement with respect to their q-values a bit liberally, we find our assumption more or less corroborated. Of the tribal groups, the Kolis, particularly those living in Cutch, have provided and do till today, the loose elements which have canalised alien blood in the veins of other castes, as well as in their own.

19. Except the tribal groups and that also in a very general way, no other social group in cultural Gujarat can be safely placed in any particular constellation. This may be due to the following reasons singly or in combination. (1) Cultural Gujarat is racially a homogeneous area. Whatever might have been the racial complexion of Gujarat in earlier days, today the various strains have got mixed up and that is why, from the mean values of the head measurements, Gujarat stands out as a mesocephalic province. Without anticipating the results of the statistical analysis of the anthropometric data, we may distinguish at least two racial types in cultural Gujarat, one brachycephalic and leptorhine, the other dolichocephalic mesorhine while in between these two types are found a large number of mixed ones showing varying degrees of intra-group association. There is no type today which can be exclusively found in any cultural group, though the indications are that the higher castes show more of brachycephaly than the lower castes, the tribal groups being predominantly dolichocephalic. (2) Cultural Gujarat had a migrant population. From the early prehistoric times, Gujarat had swayed her influence all over India so that the composition of the population in Gujarat could not remain stable. Even in the historic period, Gujarat has absorbed and assimilated various alien strains, and the incompatibility of such admixture may have been reflected in the composition of the blood of her population. The Muslim population in Gujarat, Kathiawar and Cutch have not been a stable community. At one end it has absorbed the Mediterranean strain which entered India both by land and sea; at the other end, it could infuse its blood into some of the higher castes like the Luhanas and the Bhatias who are predominantly brachycephalic. Like the Makranis who are today a mixed people resulting from mixture between the immigrant Baluchis and the tribal groups, usually from Baluchi father and Bhil or Koli mother, the various Muslim groups are recruited from intermixture between the immigrant Muslims and the Hindu castes, mostly upper ones. There are also Negroid infiltration in the maritime States in particular.

20. Assuming that the blood group frequencies among the castes and tribes do not give us any other information than that of heterogeneity, we may yet find out degrees of association and remoteness, provided we know the cultural background of the social groups. The Sunni Borahs stand out as a separate constellation from the other Muslim castes. We are told that they are a closed group. The Waghers and the Luhanas whom we tested at places where they have been living for generations could be taken as endogamous and closely knit groups. There is very little difference in the blood group gene frequencies between Waghers and those of them who have accepted Islam. The Khojas have been recruited from the Luhana caste mostly, and their association with some of the tribal groups and the Kharwas, probably suggests isolation which however is not the case with the Muslims of other Provinces who are also converts from Hinduism. The Memons and the Mianas are closely related. The Rabaris are a local group in Kathiawar and they seem to have maintained their racial type as they are easily distinguishable by their tall stature and graceful features. The Audich Brahmins, Nagar Brahmins, Bhatias, Mehars, Mianas and Kunbi Pattidars form a constellation with respect to their p-values. Most of the other groups show an erratic distribution which may be due either to genic disbalance or due to large-scale intermixture or to both. Even the Parsis are a mixed stock. The high class Parsis are an inbred lot, but the poorer section is certainly outbreeding even today and the latter outnumber the former. The serological status of the Parsis is similar to that of the upper castes in Gujarat but the high incidence of B affiliates them more to the lower castes or mixed groups elsewhere, and that is probably due to the fact that our sample from Parsis contained more blood from Parsi children belonging to poor parents, mostly students of a Parsi School of the endowed type.

21. To sum up, it is indeed doubtful if we can say much about the racial distance of the tribes and castes of Cultural Gujarat on serological evidence alone. The tribal groups, the Mehars, the Waghers and the Rabaris can be isolated from the higher castes and the Parsis, but that dissection may not be safe for all practical purposes. Although the Muslim groups show some differences among them, they do not appear to be distant from the high castes, particularly from the Luhanas, the Bhatias and the Brahmins. The Kharwas and the Macchhis are intermediate between the higher caste groups, and the tribal and the Parsis approach the Hindu castes more with respect to q-value, while the Bhangis of Gujarat, more exactly of Kathiwar, for they were measured from Porbunder and Nawanagar States, form a constellation on the basis of r-value. The arrangements indicated in the text are only tentative and we shall anxiously await the anthropometric evidence.

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TABLE 1.

BLOOD-GROUP FREQUENCIES FOR DIFFERENT CASTES AND TRIBES
AND THEIR AGREEMENT WITH BERNSTEIN'S THEORY

Castes and Tribes	Total No.	Frequency				χ^2	Probability
		O	A	B	AB		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Melurs	104	32	38	28	6	1.8069	.20> P> .10
Sunni Borahs	132	45	27	54	6	1.9696	.20> P> .10
Kuubi Pattidars ..	134	40	34	44	16	.3993	.70> P> .50
Luhanas	147	42	30	61	14	.0200	.90> P> .80
Parsis	231	70	54	84	23	.0099	.95> P> .90
Rabaris	134	44	35	39	16	1.0789	.30> P> .20
Bhangis	126	30	36	38	22	1.7191	.20> P> .10
Khojas	120	36	28	42	14	.1982	.70> P> .50
Nagar Brahmins ..	107	36	35	28	8	.3482	.70> P> .50
Waghers	120	46	26	40	8	.0184	.90> P> .80
Satwaras	100	25	25	38	12	.0012	.98> P> .95
Audich Brahmans ..	106	36	24	31	15	3.3979	.10> P> .05
Machhis	108	30	36	24	18	2.9891	.10> P> .05
Kharwas	106	40	24	30	12	.0743	.80> P> .70
Memons	100	25	24	40	11	2.0571	.20> P> .10
Mianas	100	24	26	40	10	.5487	.50> P> .30
Bhatias	106	32	31	29	14	.9316	.50> P> .30
Panchmahal Bhils ..	369	137	101	98	33	.8107	.50> P> .30
Rajpipla Bhils	156	60	38	45	13	.2844	.70> P> .50
Khandesh Bhils ..	200	80	58	48	14	.0254	.90> P> .80
Kolis	100	32	21	36	11	.4422	.70> P> .50
Miscellaneous Tribal ..	100	33	23	35	9	.0064	.95> P> .90

TABLE 2
ESTIMATED GENE PROBABILITIES AND THEIR STANDARD ERRORS
FOR THE 22 CASTES AND TRIBES

Caste or Tribe	Gene	Estimated Probability	Variance	Percentage and Standard Error
(1)	(2)	(3)	(4)	(5)
MEHRS	O	0.574675	$\times 10^{-3}$ 1.396810	57.4675 \pm 3.7376 %
	A	0.243474	1.023038	24.3474 \pm 3.1984 %
	B	0.181851	0.791906	18.1851 \pm 2.8141 %
SUNNI BORAHs	O	0.600490	$\times 10^{-3}$ 1.074760	60.0490 \pm 3.2787 %
	A	0.135359	0.477051	13.5359 \pm 2.1843 %
	B	0.264151	0.864817	26.4151 \pm 2.9407 %
KUNBI PATTIDARS.. .. .	O	0.537550	$\times 10^{-3}$ 1.197711	53.7750 \pm 3.4612 %
	A	0.207052	0.666270	20.7052 \pm 2.5813 %
	B	0.255398	0.798693	25.5398 \pm 2.8261 %
LUHANAS	O	0.536365	$\times 10^{-3}$ 1.042651	53.6365 \pm 3.2296 %
	A	0.163129	0.507671	16.3129 \pm 2.2530 %
	B	0.300506	0.861000	30.0506 \pm 2.9343 %
PARSIS	O	0.549459	$\times 10^{-3}$ 0.649182	54.9459 \pm 2.5479 %
	A	0.183382	0.359116	18.3382 \pm 1.8950 %
	B	0.267159	0.497854	26.7159 \pm 2.2314 %
RABARIS	O	0.558998	$\times 10^{-3}$ 1.101675	55.8998 \pm 3.3196 %
	A	0.211039	0.701058	21.1039 \pm 2.6478 %
	B	0.230063	0.755671	23.0063 \pm 2.7490 %
BHANGIS	O	0.466419	$\times 10^{-3}$ 1.270159	46.6419 \pm 3.5637 %
	A	0.261431	0.892847	26.1431 \pm 2.9880 %
	B	0.272150	0.923348	27.2150 \pm 3.0386 %
KHOJAS	O	0.539122	$\times 10^{-3}$ 1.261868	53.9122 \pm 3.5525 %
	A	0.192687	0.722053	19.2687 \pm 2.6872 %
	B	0.268191	0.961021	26.8191 \pm 3.1000 %
NAGAR BRAHMINs.. .. .	O	0.586302	$\times 10^{-3}$ 1.335214	58.6302 \pm 3.6538 %
	A	0.227549	0.938170	22.7549 \pm 3.0630 %
	B	0.186149	0.786268	18.6149 \pm 2.8041 %
WAGHERS	O	0.620776	$\times 10^{-3}$ 1.135871	62.0776 \pm 3.3705 %
	A	0.153593	0.589661	15.3593 \pm 2.4284 %
	B	0.225631	0.831257	22.5631 \pm 2.8832 %
SATWARAS	O	0.500625	$\times 10^{-3}$ 1.570008	50.0625 \pm 3.9623 %
	A	0.206360	0.919563	20.6360 \pm 3.0325 %
	B	0.293015	1.238799	29.3015 \pm 3.5199 %

TABLE 2—(contd.)

ESTIMATED GENE PROBABILITIES AND THEIR STANDARD ERRORS
FOR THE 22 CASTES AND TRIBES—(Concluded).

Caste or Tribe	Gene	Estimated Probability	Variance	Percentage and Standard Error
(1)	(2)	(3)	(4)	(5)
AUDICH BRAHMINS ..	O	0.555424	$\times 10$ 1.399803	55.5424 \pm 3.7417 %
	A	0.201334	0.850190	20.1334 \pm 2.9158 %
	B	0.243242	1.002335	24.3242 \pm 3.1654 %
MACHHIS	O	0.498648	$\times 10$ 1.455470	49.8648 \pm 3.8144 %
	A	0.287272	1.128514	28.7272 \pm 3.3601 %
	B	0.214080	0.879266	21.4080 \pm 2.9653 %
KHARWAS	O	0.594751	$\times 10$ 1.331930	59.4751 \pm 3.6497 %
	A	0.185053	0.789498	18.5053 \pm 2.8098 %
	B	0.220196	0.920684	22.0196 \pm 3.0343 %
MEMONS	O	0.504690	$\times 10$ 1.569275	50.4690 \pm 3.9611 %
	A	0.194377	0.872524	19.4377 \pm 2.9538 %
	B	0.300933	1.266509	30.0933 \pm 3.5595 %
MIANAS	O	0.502875	$\times 10$ 1.568710	50.2875 \pm 3.9611 %
	A	0.201718	0.901490	20.1718 \pm 3.0025 %
	B	0.295407	1.247340	29.5407 \pm 3.5313 %
BHATIAS	O	0.534225	$\times 10$ 1.429660	53.4225 \pm 3.7815 %
	A	0.238984	0.986386	23.8984 \pm 3.1407 %
	B	0.226781	0.942736	22.6781 \pm 3.0703 %
PANCHMAHAL BHILS ..	O	0.602775	$\times 10$ 3.778824	60.2775 \pm 1.9440 %
	A	0.201141	2.442700	20.1141 \pm 1.5630 %
	B	0.196084	2.388398	19.6084 \pm 1.5453 %
RAJPIPLA BHILS ..	O	0.614444	$\times 10$ 0.879057	61.4444 \pm 2.9650 %
	A	0.178944	0.520735	17.8944 \pm 2.2819 %
	B	0.206612	0.592006	20.6612 \pm 2.4331 %
KHANDESH BHILS ..	O	0.630993	$\times 10$ 0.667450	63.0993 \pm 2.5836 %
	A	0.199821	0.448373	19.9821 \pm 2.1175 %
	B	0.169186	0.386275	16.9186 \pm 1.9655 %
KOLIS	O	0.555556	$\times 10$ 1.492103	55.5556 \pm 3.8626 %
	A	0.174233	0.792312	17.4233 \pm 2.8148 %
	B	0.270211	1.161401	27.0211 \pm 3.4073 %
MISCELLANEOUS TRIBAL ..	O	0.573274	$\times 10$ 1.458483	57.3274 \pm 3.8184 %
	A	0.175247	0.797242	17.5247 \pm 2.8235 %
	B	0.251479	1.094373	25.1479 \pm 3.3076 %

TABLE 3. THE PARTITION OF χ^2

Source.	Degrees of Freedom	χ^2
Differences in p	21	35.229884*
Remainder	21	46.895298***
Total	42	82.125182

Source.	Degrees of Freedom.	χ^2
Differences in q	21	47.572645***
Remainder	21	34.552537*
Total	42	82.125182

Source.	Degrees of Freedom.	χ^2
Differences in r	21	40.211020**
Remainder	21	41.914162**
Total	42	82.125182

PART II
ANTHROPOMETRIC STATUS OF THE CASTES AND TRIBES*
OF MAHA-GUJARAT

By

D. N. MAJUMDAR AND A. R. SEN

22. We have already mentioned in the Serological Report that the Racial and Serological Survey of Gujarat was completed in 1946, and it was undertaken at the initiative of the Gujarat Research Society. The extensiveness of this enquiry will be evident, when it is known that the total number of people we measured was nearly 3,000 and we sampled 3,000 blood groups belonging to 24 cultural groups in Maha-Gujarat. The same technique and methods as were developed for the U.P. and Bengal Surveys, carried out earlier, were employed in Gujarat so that for the requirements of random sampling our effective data are somewhat less than the total number of subjects we measured. The scheme as was decided in consultation with the Anthropological Survey Committee of the Society, stipulated the measurements of 24 castes of Maha-Gujarat, each group to consist of more than 200 individuals. This, however, could not be possible as the method of randomisation of samples adopted in the U.P. and Bengal require double the number to choose our subjects from. The response of the people to anthropometric tests cannot be, by any chance, such as to bring together a large number of people for the purpose, and even those who assemble for the sake of curiosity evaporate too quickly even before we settle down to our work. Besides, the time at our disposal was not too long, the money available was also limited while the distances we had to cover, the conditions of railway travel these days, shortage of petrol, the large number of places we had to visit, mostly rural, all conspired to make it physically impossible to achieve more than what we have done. One thing, however, is that the data of Maha-Gujarat, of Bengal, and of the U.P., having been collected by the same investigator and with the same technique, are comparable, and we have every reason to believe that it will reveal what similar anthropometric and serological data have done so far.

23. In the map published along, we have given the places we have visited and the social groups we measured. We started our enquiry in the Rajpipla State where we received all the facilities required for our investigation. The then Diwan of Rajpipla, Khan Bahadur Kothawala, made all the arrangements and we selected a number of places where the Bhil, the Machhi, the Rajput, and the Kunbi Patidar were concentrated. We also measured a group of Sunni Bora in the Rajpipla State. From Rajpipla, we went to Bilimora and neighbouring villages where we measured some of the artisans and the Parsi. From Bilimora we proceeded to Ahmedabad where we got our data from the various textile mills, the labourers for

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which were mostly recruited from the aboriginal and semi-aboriginal communities and the miscellaneous artisans. We also could measure some Brahmins both Audich and Nagar, and some Oswal Jain. From Ahmedabad we proceeded *via* Viramgram to Rajkot, from Rajkot to Jamnagar, from Jamnagar to Samdhiala, to Jashdan and *via* Botad and Jetalsar, we went to Porbandar; from Porbandar to Dwarka, Methapur and back to Jamnagar, from Jamnagar to Kandla and to Bhuj. We travelled over extensive country in Cutch and reached many centres including Anjar, Kera, Kandla and Navalakhi and retraced *via* Viramgram to Ahmedabad and to Bombay. In Bombay, we did a large number of blood group tests, and we also measured the Parsi. Everywhere we went, we received full cooperation and the required facilities from the authorities concerned. Any omission is due to the nature of our investigations and the ignorance of the people about our mission. Anthropometrical investigations along with serology do not appeal to people and it has been a real uphill work, but from the methods we followed and the general response we got, the data should provide adequate material for the comparative study of the ethnic groups in the cultural area, we undertook to survey.

24. We have measured three Bhil groups, one from the Panchmahals, a second from Western Khandesh and a third from the Malsamot plateau in the Rajpipla State. The total number of Bhil we have included in our Survey is 601. Table 5 details the mean measurements with standard errors of ten characters of the three Bhil series. Table 2 presents the numerical differences in measurements for any two of the three groups with regard to these ten characters. The differences which are statistically significant at 5 %, 1%, 1% level have been shown in Table 6 with one or two and three asterisks respectively against them. From the study of the Table 6, it will appear that with regard to 6 characters, namely, stature, maximum head length, bizygomatic breadth, nasal length, total facial length, upper facial length, the Panchmahal Bhil seem to be significantly different from both the Rajpipla and Khandesh Bhil, there being little significant differences between the latter. In the characters, bigonial breadth and nasal depth, the groups show divergence. In respect of maximum head breadth, the Khandesh Bhil are significantly different from the Panchmahal and the Rajpipla Bhil who appear to be akin to one another. In regard to nasal breadth, the Panchmahal and Khandesh Bhil are alike but different from Rajpipla Bhil. It would be interesting to note that with regard to 8 characters the Panchmahal Bhil have higher measurements than Rajpipla and Khandesh Bhil. Thus in respect of 6 characters, namely stature, maximum head length, bizygomatic breadth, nasal length, total facial length and upper facial length, the divergence pattern amongst the three groups of Bhil remains the same, that is to say, Rajpipla and Khandesh Bhil behave as samples from the same population, while Panchmahal Bhil showed a divergence, no such marked constancy is noticeable with regard to the remaining 4 characters, namely, the maximum head breadth; nasal breadth, bigonial breadth and nasal depth, which have, therefore, been omitted for the purpose of comparison.

25. On the basis of the Bhil data the following conclusions are possible, but in the intergroup relations the various Bhil groups have been found to behave similar-

ly with regard to other tribes and castes of Maha-Gujarat. The intra-group affiliation can be stated as below :—

- (A) When a tribe is scattered over a large area, those who live in contiguous districts show greater affinity between them than those who live separated.
- (B) When a tribe is distributed over hills and forest and also lives in plain districts, the former is bound to maintain its racial status more than the latter.
- (C) The degree of inter-mixture of the various racial types is more or less proportional to the amounts of contacts they have, but the chances of intermixture are greater in the plains than they are in the hills and inaccessible regions.

26. Another fact that has transpired from anthropological and serological investigation amongst the various Bhil groups has been the racial distance the Bhil show from the austroloid and proto-austroloid or pre-Dravidian tribes living in Bihar and Peninsular India with whom they have all along been identified. The Panchmahal Bhil for example, when compared with the various tribal groups in the U. P., namely the Korwa, the Majhwar, the Kharwar, the Panika, the Chero, the Rajwar, the Oraon, show on anthropometric evidence dissociation with the latter. The Bhil of Panchmahal were found distant even from the semi-aboriginal or the scheduled castes of the U. P. Mahalanobis, Majumdar, and Rao (U. P. Anthropometric Survey Report, 1948)* could not find much affinity between the Panchmahal Bhil and other tribal and semi-tribal groups, though they could find association of the Bhil with the Dom of U. P., who were dissimilar to the tribal groups, mongoloid and austroloid. The Dom are a hybrid community and both from anthropometrical and serological evidence, their racial status is uncertain. The Bhil may be regarded as a hybrid group in Gujarat, on the one hand absorbing Rajput blood, on the other representing a tribal substratum. The position of the Bhil with regard to the various castes of Gujarat, while indicating their tribal origin, is not very much distinct from some of the stable communities with advanced cultures.

TECHNIQUE AND INSTRUMENTS

27. The measurements were all taken by Dr. D. N. Majumdar and they were recorded by his assistants Mr. Sher Singh, Mr. T. B. Naik, Mr. S. C. Roy (who remained with us for a short period being drafted to the Anthropological Survey while in harness) and by local officials who were deputed to assist in the Survey. The photographs were taken by Mr. Sher Singh, who was staff photographer to the Survey. Blood group work was assisted by Mr. T. B. Naik, research student in Anthropology, Lucknow University, deputed by the Gujarat Research Society for training at Lucknow; he also helped in the preparation of ethnographical notes while statistical work was assisted by Mr. S. Bahadur, research assistant, Anthropology Laboratory, Lucknow. Similar methods of checking the readings and

* Sankhya, Vol. 9, Parts 2 and 3 (1949).

the instruments as in the U. P., and Bengal Surveys, were also adopted in Gujarat. The assistants were asked to test the readings by suddenly interrogating the measurer about a particular measurement of a subject so that the same could be measured over again and the results verified, a procedure which provided control over the mechanical transfer of the data.

28. We selected a few measurements for the obvious advantage in the statistical analysis of the data, also because of the difficulty of making a subject submit to the anthropometric ordeal for a longer period than he would voluntarily do so. We were provided with the anthropometer, sliding calipers, spreading calipers, steel metric tape, spanner, colorimeter and standard beam scales. The entire paraphernalia for testing blood groups, were carried as in the U. P. Survey, in specially made steel cases. One of the latter carried the microscope, the centrifuge and apparatus for testing hæmoglobin percentages.

29. The following 13 measurements were taken : i. Maximum Head Length ii. Maximum Head Breadth, iii. Minimum Frontal Breadth, iv. Maximum Bizygomatic Breadth, v. Bigonial Breadth, vi. Nasal Length, vii. Nasal Breadth, viii. Auricular Height, ix. Total Facial Length, x. Upper Facial Length, xi. Stature, xii. Sitting Height and xiii. Weight.

(i) *Maximum Head Length*.—This was measured with the help of the spreading calipers. The maximum glabella-occipital length in the median sagittal plane was recorded. Standing on the left of the subject and holding caliper point between the thumb and first finger of the left hand, it was placed on the glabella, the right hand moved the other caliper point up and down the median occipital line until maximum reading was obtained ; while fixing the calipers' point on the glabella, care was taken that no pressure was exerted.

(ii) *Maximum Head Breadth*.—The maximum breadth of the head perpendicular to the median sagittal plane was taken. The points of the calipers were applied lightly to the head, being kept in the same horizontal and lateral vertical plane. The points were moved forward and backward up and down till a maximum reading was obtained, the observer standing in front of the subject, holding the arms of the calipers just above their points.

(iii) *Minimum Frontal Breadth*.—This was taken with the spreading calipers the smallest distance between the temporal crests on the frontal bone above the brow ridges, the points of nearest approach to the temporal crests were determined first by means of the thumb and the forefinger and the tips of the calipers were then applied to these parts.

(iv) *Maximum Bizygomatic Breadth* or the maximum diameter between the zygomatic arches was measured by "holding the calipers' arms near the extremities in the right and left hands between thumbs and second fingers with the forefinger palpating to make sure that the calipers' points were actually on the zygomatic arches."

(v) *Bigonial Breadth*.—The diameter between the gonion was measured by the spreading calipers, the arms of which were held in the hands and index finger located the most laterally projecting angles of the mandible at the junction of the ascending ramii with the horizontal ramii.

(vi) *Nasal Length*.—This was measured from the nasion to subnasale. The sliding calipers were used and the upperpoint was the nasion located by running the thumb nail of the right hand up the bridge of the nose, until the edge of the thumb nail found the groove marking the naso-frontal suture, the lower point was the junction of the nasal septum with the lip. This measurement was the most difficult to make and the subject also showed uneasiness in some cases.

(vii) *Nasal Breadth*.—It is the maximum breadth between the most lateral parts of the nasal alæ. It is a contact measurement and no pressure was exercised.

(viii) *Total Facial Length* was taken from the nasion to gnathion, the midpoint on the lower border of the mandibular symphysis. The mouth of the subject as also the teeth were closed, the latter being kept in occlusion. The distance between the nasion and the point in the middle of the chin under surface of the mandible was measured while the subject was seated in a chair. It was found convenient to press the nail at the nasion to keep a mark. As this measurement followed the nasal length, the nasion could be located without further search.

(ix) *Upper Facial Length* was taken with the sliding calipers from the nasion to alveolar point. The lower point of the measurement was on the gums between the upper median incisor teeth. Although the point of the calipers was not actually contacted with the teeth or gum it was found hygienic to dip the point of the calipers every time they were used in alcohol to sterilise them and also to produce a psychological effect on the crowd so that there might be no objection against the measurements. A number of measurements had to be eliminated as the individuals otherwise healthy, had their gums receded due to dental diseases.

(x) *Stature*.—This was taken with the anthropometer. The subject was asked to stand with the heels together, arms hanging at the sides, shoulders erect, eyes horizontal, the head always being in the ear-eye plane. The anthropometer was kept in front of the subject, the end of the butt upon the wooden footplate on which the subject also was asked to stand, but when the foot plate was not available and the floor was level and hard, it was held on the floor with the axis vertical. The height was taken from the vertex.

(xi) *Sitting Height*.—It was taken with the anthropometer from the vertex to level of the plane, 'upon which the subject was seated in the most erect position possible.' A small wooden chair 40cm. high was carried along on which the subject was asked to sit keeping the thighs parallel and horizontal and the legs vertical. The lumbar curve was not allowed to be relaxed during measurement and care was taken to see that the spine was held in the erect standing position, the head being held in the ear-eye plane. The gluteal and extensor muscles of the thigh were relaxed, the subject resting on the ischial tuberosities' (of Hooton, the American Criminal, Vol. I, 1939 p. 38). The height was measured from the rear of the subject.

(xii) *Weight*.—Weight of the subjects was taken in plain clothes, without the shoes, and an allowance of 2 lbs., was made for clothes. The dress of the various groups measured differed from caste to caste; some put on *pagris*, others like the Rabaris, put on heavy woollen coats and trousers, but the subjects were persuaded to remove unnecessary apparels and thus with the deduction of 2 lbs., the weights were reduced approximately to nude weights. There is no likelihood of arriving at precision with regard to this measurement as the effect of a heavy stomach could not be estimated. Weights were recorded morning, noon, and evening and as conditions could not be equalised in all castes, the data were not used for intergroup comparisons.

(xiii) *Auricular Height*.—It is the vertical height of the head above the trignon. The subject sits with the eyes directed towards the horizon and for the measurement of head height on the left side with the head turned well to the right. The upper measuring arm of the anthropometer is pulled out of its expansion and the lower measuring arm is retracted so that the projection is about 3" for the sliding sleeve with its measuring point on the upper edge of the arm. The upper arm is placed across the head of the subject above the trignon in the transverse plane and allowed to rest there tightly while most of the weight of the instrument is supported by the grip of the left on the lower part of the vertically held tubular shaft of the anthropometer. The sliding sleeve that carries the lower measuring arm is lowered and raised until the measuring point of the arm just touches trignon. The anthropometer is kept absolutely vertical and the upper measuring arm that rests across the subject is kept horizontal. The process is repeated on the right side and the mean between the two is taken. This, we agree with Hooton, is simpler and easier, and appears more satisfactory than the spanner technique which we employed previously.

ETHNOGRAPHIC NOTES ON THE SOCIAL GROUPS MEASURED

30. 1. *Audich Brahmins*.—The Brahmins of Gujarat described by Sherring as 'Gurjars', belong to, as he says "the fifth great branch of Dravira Brahmin". The Audich are the most numerous of the Brahmin community in Gujarat and are divided into a number of sections of which some are regarded socially superior to others. Some Audich Brahmins live on alms, some are cultivators, cooks and priests; but quite a number of them have received higher education and are working in government and educational institutions. Inter-marriage between the various sections is not generally permitted, though there is no communal restriction. Some of them officiate as priests and are in charge of temples, the latter are often known by the name of the *Jajman* whom they serve. The Audich Brahmins whom we measured in Rajpipla State and in Saurashtra, are almost 300,000 in strength and are found scattered all over Gujarat. From their name which means the people of north, it appears that they may have entered Gujarat from Northern India. There is a story which says that the Audich Brahmins were invited to Gujarat by King Mool Raj of Anhalvara, A.D. 961-96, for aiding him in sacrifice. On the completion of the sacrifice, they were offered grants of land which were accepted by 1,000 amongst them who are today known as Sahasras. The others declined the offer to settle but later on a special grant was made to them which they ultimately agreed to accept,

they are known as Tolakiyas. There is not much of difference in customary life between the Audich and Nagar Brahmins. The Audich are a very literate class and have similar political status as that enjoyed by the Kayasthas of northern India.

31. *Bhil*.—The Bhil are of special interest in Gujarat owing to their numerical strength which is over two millions and to the large area they had occupied in Gujarat. The Bhili language is spoken over large area. The customs and practices of the Bhil distinguish them from other communities. The Bhil of Gujarat form a connecting link between the Bhil of Khandesh and C. P. and Marwar in south west and Mewar and Rajputana in the north. The Bhil represent different racial status and with the advance of civilization they have mixed with the various classes of Hindu Society. Racially the Bhil are not, therefore, a type. Even in their customs, it is difficult to ascertain which are indigenous and which are borrowed, as the Bhil represent various grades of civilisation from the primitive hunter to the completely detribalised Patela. The Bhil indeed have an antiquity which is evidenced by the reference about them in ancient Sanskrit literature beginning at least from 2nd or 3rd century B.C. There is a volume of evidence about the fine physical traits of the Bhil. The Hinduised Bhil such as Bhilala and Pateli possess well cut and well proportioned features, some are tall and handsome with light complexion, and even possessing fine nose and high forehead. C. S. Venkatachar traces Rajput blood in them, 'Forced by circumstances', he writes, 'to make an alliance with the denizens of Vindhya hills, the Rajput did not hesitate to take women from tribal land and this was the reason of disintegration of the Bhil into the various sections they own today.' The Ujale, Mele, and Madalye, the three sections of the Bhil, the first being of fair complexion, the third dark and the second intermediate represents the results of mixture according to the same author. The Bhil are Hindus as well as Muslims. The Tadvi Bhil according to Sorely are the muslims who were compelled to procure their women-folk locally, the descendants of these muslims and their Bhil wives and also the local converts are known in this Presidency as Tadvi Bhil. But there is another group also known locally as Tadvi Bhil residing in the northern slopes of Satpuras, who are all Hindus. Culturally the Bhil represent different levels.

32. *Bhadela*.—The Bhadela are one of the leading sea faring communities of Gujarat. They are Muslim by faith and Sunni by sect. They are probably immigrants from Arabia and are found in the ports of Cutch, Jamnagar, Dwarka and Jafarabad. Their number is approximately 5,000.

33. *Bhatia*.—The Bhatia are found mainly in Cutch and Saurashtra. They claim Rajput origin and trace themselves from the Yadvas, who are the ruling tribe in Jaisalmer in north Rajputana. The Muslim Bhatia of Lahore and Multan are claimed to be of similar origin. They are domiciled in Cutch, probably from 1350 A.D. From Cutch and Saurashtra, they have spread over Gujarat, Bombay and even Calcutta and Rangoon. They were the early colonisers in the coast of eastern gulf. The Bhatia are divided into two groups, which are hypergamous to one another. The Vishas take women from Das but seldom give their daughters in marriage

to the latter. They are divided into *gotras* and claim to possess eighty-four clans or *nukhs* which are exogamous to one another. The Bhatia are a prosperous community, able and enterprising. They have fair complexion well built bodies, they are tall and own fine features. Some of them possess even pale white complexion, majority being sallow white. The Bhatia of Cutch speak the local dialect which is affiliated to Gujarati. The Bhatia are strict vegetarian and are very much like the Luhana, though their turban has an extra peak or horn which divide them from other communities. As a community they are keen, vigorous, thrifty and clever. They are the keenest of traders and have subtle intellect. They are the Vaishnavas, but respect the Brahmin Gods, worship Vishnu in the shape of Ramchandraji and also Radha Krishna. They observe Hindu fasts and feasts and put on sacred thread. They do not allow widow marriage neither they allow divorce. They tolerate polygyny only when the first wife is barren or has deserted. There is a lot of solidarity amongst the Bhatia and they are respectable.

34. *Bhangi*.—The Bhangi who number about 3 millions, in the 1941 Census are the second largest untouchable caste. They claim descent from a Brahmin sage who carried away and buried a dog that died on the occasion of an assembly of Brahmins. The Bhangi are short, strongly built, dark in complexion, and their features like the Dom of northern India vary from place to place resulting probably from intermixture with other communities. The women are proverbially immoral, who canalise alien blood into the community. The Bhangi are terribly shrewd and traditionally cunning. The men wear turban and jacket, a pair of trousers reaching the knee or in some parts they put on *dhoties*. Women wear petti-coat and bodice and a cloth as do men to cover the waist upward. They speak Gujarati and understand Hindi. They usually live outside the village boundary, and in small huts. Millets and pulse, meat and fish constitute their diet. They are scavengers, and remove filths and night soil. They are Municipal scavengers in both India and Pakistan. Their supplementary occupation is making of baskets and *Chiks*, which they make from bamboo. They work also as watchmen, drummers, and hangmen. Besides all the Brahmin gods and goddesses, they are fond of worshipping Hanuman, Shikotri and Devi. The Bhangi are divided into *gotras* which are exogamous. Each locality has a Panchayat which is very powerful and competent to look after the interest of the castes.

35. *Koli*.—The Koli are a widely distributed community in the Bombay Presidency, forming as much as 25 per cent. of the total Hindu population of Maha-Gujarat. At one end of the social ladder the Koli is an aboriginal, and at the end they are an agricultural caste who constitute the bulk of the labour population in the textile mills and factories. They are also porters, carriers, boatmen, even thieves and dacoits. They are many Koli who are pretty advanced in culture, polished in manner, who can with difficulty be distinguished from other high caste Hindus. On the one hand, the Koli are of dark complexion, short stature, long headed and resemble the Australoid elements in India's population, on the other the cultured Koli have high-caste features and are often indistinguishable from the latter. The women are often good looking and possess a fine figure but they generally age earlier, probably due to hard work that is their lot both indoor and outdoor. There is a

lot of professional prostitution amongst the low-born Koli and their women are known to migrate to Sind and adjacent provinces for a career of 'easy' virtue. Most notoriously intemperate, they consume spirits in quantity whenever they can afford. Men and women are fond of chewing tobacco. Smoking is a passion with them. The teeth acquire a dusky film from early age till a dark coat is laid on them. Most of the Koli pray to Hindu gods and goddesses, and they are worshippers of Mahadeo also Indra and Hatmal. Sherring refers to a tradition of the origin of the Koli. This traces the latter from the celebrated author of Ramayan, Valmiki. From the appearance of women and the general physical features of men, the Koli are of a mixed descent and in recent times a lot of alien infusion has been canalised into the tribe through clandestine or overt but illicit intimacy, with the non-tribal elements. The Koli have often provided a mercenary army to the Marhatta dynasties, and since then they have continued their predatory exploits. The Koli dress varies from a *langoti*, or a cloth with a rag for the head among the hill Koli, to turban, coat, and trousers, and shoulder clothes amongst the Koli Chiefs. The women put on petticoats, and sided bodice and a robe; *Jowar* and *Bajri* bread, dal, and rice constitute the Koli's daily diet. Men are fond of fish and meat if they can afford. The Saurashtra Koli are notorious for drunkenness. Many Koli are followers of Swaminarain and of Kabir Sects. They allow widow remarriage and also divorce. They have a strong Panchayat organisation and their ordinary quarrels are settled by Panchayats.

36. *Kunbi Pattidar*.—The Kunbi are a numerous agricultural caste of Maharashtra. They are divided into four divisions, Angena, Kadva, Leva, and Mitia and between them they constitute about 16% of the total Hindu population of Gujarat. Although scattered over the provinces, they are more numerous between Saurashtra and Malva. There is little unanimity about the origin of their name. Some trace it from the Sanskrit *Kristmi*, a ploughman. Pandit Bhagwan Lal, Indrasji traces it from *Kutumb*—a household. The Kunbi themselves believe that their name has come from *Kan*-grain and *Bi*-seed. There is also a tradition about their descent from Lava and Kush, the twin sons of Ram and Sita. The Kunbi are not easily distinguishable from Bania. The agricultural Kunbi are darker and stronger. Their houses substantial, roomy and they are fond of furniture. The men normally put on waist clothes, and turbans or a loose *pheta*. The women wear petticoat, a *sari* and a bodice. They are not fond of drinks and neither do they eat meat ordinarily. The urban and more advanced Pattidars are skilled workers of silk and cotton, grain dealers, money lenders, and the educated amongst them are state servants, and crowded the liberal professions. There are many who are big landlords. There is a great hold of religion on them. Kunbi belong to many sects, Dadupanthis, Kabirpanthis, Pranamis, Shaivas, and followers of Madhavacharya, Swaminarain and Balabhacharya. Their customs and religious beliefs and practices are similar to those of the Brahmin. Substantial families pay heavy dowries to the bridegroom, and widow remarriage is recognised. The rural Kunbi allow divorce and practise polygyny.

37. *Khoja*.—The Khoja are an important trading community of Gujarat mostly urban but there are many villages in Cutch which are inhabited by the Khoja alone. Originally Hindus, physically akin to the Luhana and the Bhatia from

whom they are said to have been converted some four or five hundred years ago. Their business connection extends all over India, Burma, Africa and the Mediterranean ports. A very enterprising community, clanish to a degree and fabulously rich. They wear a long coat, pyjama, a peculiar turban, the women wear a long shirt, *salwar*, and have a scarf over their heads. Some have taken to *sari* which they put on either in Gujarati or Bengali fashion. They are disciples of H. H. the Aga Khan, and each Khoja voluntarily contributes a share of his income to this religious head. They have similar customs and practices to those of the Hindus with whom they live, otherwise they are aggressively muslims.

38. *Kharwa*.—Like the Machhi the Kharwa are a coastal population and are salt carriers, thickly scattered in the ports of Cutch, Saurastras and south Gujarat. They are sea faring and many serve as laskars in the Indian Ocean. They claim Rajput descent as all semi-aboriginal people do it, although their surnames do not justify their claims. The Kharwa of Porbandar own six names, viz, Gudhara, Khodara, Kotara, Seragi, Todarmal and Bhandari. They are of dark complexion, short stature, and strongly built, easily distinguished from others by their long whiskers but shorn of beards. They wear short *dhoties* and short trousers, the latter is found more frequent in Saurastras and Cutch. They are fond of fish and meat and drink liquor and toddy to excess. Many of the Kharwa have visited Aden, and the coastal ports of India, also as far east as Singapore. Few of them are cultivators, they are worshippers of Ambas, Bhadrakali. In Porbandar they worship Delwadi, Mamai, Padmini, and Mata. They all allow levirate and widow remarriage, believe in omens, and witchcraft, and evil eyes. They venerate the cow, the planets, the sun, the moon. On the full moon day of *Sravan*, the Kharwa of Porbandar worship the sea. They are an adventurous lot and extremely improvident.

39. *Luhana*.—The Luhana are chiefly found in Kathiawar, Cutch and in present Saurashtra. They are not numerically very strong as their number has been computed to be about 15,000. They are Rajput in origin. Some trace themselves from Luhanapur, Lohocot in Multan, from where they have been said to be driven out towards the 13th century. Another tradition traces them from Kanauj and to the Rathors who had migrated to Cutch about the 13th century. They are usually tall, of fair skin, with well built bodies, fine nose, expressive and dark eyes and they speak Cutchy. They are a vegetarian lot and seldom eat fish and meat. The Luhana are an important business community some of whom are very rich. They were in earlier centuries State bankers, and ministers in Cutch. They are Vaishnavas of Ballabhacharya and Ramanuj sects. They are not distinguishable from the other high caste Hindus in dress or in cultural life. The family goddess to which they offer periodical prayers is Ram Deo, Mata and they also worship the spirit of the Indus, whom they address as Dariapir in faithful remembrance, it is said, of the help rendered to them by the spirit when they were forced to flee from Multan. Every Luhana village worships the Pir and has a place built in his honour where a lamp is kept burning day and night and every year in the month of Chait (March / April), they celebrate a festival in his honour. They put on sacred thread and tolerate polygyny and widow remarriage. The Bhatia are their nearest kin from whom

they are culturally indistinguishable. Like the Rajput elsewhere they own a head man and observe rigid caste prescriptions.

40. *Lohar (Artisan)*.—Lohar are iron smiths and work in iron. They supply the agricultural tools for the villagers and they are widely scattered. In Bombay and Gujarat, they are divided into two sects, Marathi and Bundeli.

41. *Machhi*.—The Machhi are fishermen, found scattered in the coastal towns and villages of Gujarat, Saurashtra and Cutch. They are also met with on the banks of inland rivers. A big crowd of Machhi live in Rajpipla State. They are often indistinguishable from the Koli and in some districts, they pass as such. In the Panchmahals according to tradition, they are the progenies of a sage called Gautam who is said to have transformed a man into a woman whom he married later on. Another tradition claims for them a Rajput origin. Their ancestors gave up their occupation of fighting as an escape from the wrath of Parasuram, who was determined to eliminate the Khsatrias all over the land. They sought refuge from a *rishi*, who initiated them into their present occupation, namely fishing. The Machhi are dark, short, but powerfully built. They live on fish and meat and are very fond of liquor, particularly toddy and are opium addicts as well. Where fishing is not profitable and seasonal the Machhi ply boats on hire, sell vegetables and work as small cultivators and labourers. They pray to two female deities, Shigotri and Hinglaj but they are adept in magic which usually they invoke in their principal occupation of fishing. On deep water fishing they resort to magic and carefully avoid the evil eye.

42. *Memon*.—The Memon are converts from the Hindus and yet they observe many Hindu customs and practices. Some Memon are known to employ Brahmins or they employ the *Kazi* and the Brahmins simultaneously. They are a cultivating community and similar to the Bora in dress and habits. The Memon in Cutch are said to be converts from the Luhana and the Bhatia castes and Sunni by faith. The Memon of Cutch are very adventurous and are important merchants in Bombay and elsewhere.

43. *Mher*.—The Mher are representative of a martial caste in Gujarat and in Porbandar. They constitute a sort of national militia. Their duty as protector of villages, secured for them grants of land from the villagers. Even now the Mher where they live, are exempted from all taxes and are obliged for military service. They are a picturesque people, well dressed, armed with sword and shield, and physically very strong. They are of the same racial type as the Rajput and probably are a purer type than the Rajput of Gujarat and in Porbandar they are very loyal to the Maharaja. They are known for their bravery and hospitality. Often they have been accused of crime in which violence is reported. The Mher, Kathi, Ahir, the Gurjar, Scythian, Greek, Bacterian, Pathan, are known to be foreign elements in the Gujarat population.

44. *Miana*.—The Miana are found in Kathiawar and Cutch. They were originally Hindus later on converted into Islam. They are a wandering and nomadic people who cause lot of anxiety to the administration. Often they were a menace

and their lawlessness had to be put down ruthlessly. They have taken to land but many are still vagrant, thieves and dacoits. They are a strong people and are remarkably courageous. Physically, the Miana show great similarity to the Rajput. Sherring writing about the Miana of Kathiawar, says that they are a sect of low Mohomedans, who permit the women to live with other men during their husband's life time.

45. *Nagar Brahmin*.—They are a cultured community in Gujarat, Cutch and Saurashtra. They are found also in parts of the U. P. and in the Punjab. They own six main sub-divisions, namely, Chitodra, Karashnora, Sathodras, Bhaidnagar and Vixnagar; they are divided also into secular and spiritual Brahmins. The former are known as Shashtra, the latter as Bhikshu. The Nagar have a number of traditions regarding their origin. One tradition says that the Brahmin who was called to officiate at Shivas's marriage with Parvati, was so much fascinated by the latter's beauty that he could not hold himself and left the marriage with others. Finding, however, there was nobody to officiate at the ceremony, Shiva created Brahmins from six grains of rice and they were married to six Naga girls. These were the progenitors of the Nagars. Another tradition claims Shiva to have created the Brahmins, the Nagar from six grains of rice from his forehead where these were pasted during his marriage with Parvati. They are mostly worshippers of Shiva, whom they represent as Shri Hat-Kasher. All customs and practices of the Nagar find their echoes in Grihasutra. Nagar are invested with sacred thread any time in the third to the fifth year and marry in the 20th and above. The girls also marry late unlike the other Brahmins. The family goddesses are worshipped before marriage and widows are not allowed to remarry, neither they practise polygyny. The Nagar have much in common with the Kayasthas and Brahmins of Bengal who constitute the Bhadralog community there. The Nagar are educated and in 1941, they showed the highest literacy percentage in the Baroda State. Many Nagar are found in State services in all parts. The high percentage of literacy and of the educated amongst the Nagar have made them quite liberal in their views and they are not very orthodox in their temperament or in their customary observances. The Nagar in Cutch are quite orthodox due probably to their stay-at-home habits.

46. *Oswal Jain*.—The Oswal are an important trading community and quite substantial in Ahmedabad and other parts of Gujarat. The Oswal whom we measured from the villages in Cutch, trace themselves from Osai nagar, near Jodhpur. Originally they were Rajput but became converted into Jainism at about the 8th century. It is said that the conversion followed because of the cure from a snake bite of the son of a chief through a Jain priest. A second tradition says that the Shri Mal King Deshal allowed none but millionaires to live in the city. One of the fortunate citizen, a Shri Mali Bania, named Ruad had a brother whose fortune did not come up to the expectation of the chief, the latter begged of his brother to help him to make up the required million which the lucky brother did not. Disappointed he and many others of the Rajput, left Shri Mal and settled in a village called Osa, or the frontier. They put on tied pyjamas and frog-coat whose ends are tied to a loose turban on the head. In Cutch most of the Oswal live by cultivation and have coarse look. They are Jain by faith and vegetarian by choice. The Oswal have a light brown comple-

xion, medium stature, round head, and a few of them were found to possess mongoloid folds.

47. *Rabari*.—The Rabari are a distinct type in Gujarat, Cutch and Saurashtra ; tradition has it that the Rabari were originally Rajput who married Apccharas or celestial dancers and thus became Rahabari or Rabaris. Men and women among the Rabari possess a strong physique, tall and well built, have fair complexion, large and expressive eyes, oval faces, vertical forehead and fair skin. They are very tall and compete very favourably with the Mher and the Kathi but the honours are likely to go to Rabari, if not to the Kathi. The women are tall, graceful, and have fine figures, capable of balancing four to five big pots of water on their head and shoulders. The average dress of Rabari is similar to that of Rajput cultivators. They always carry a loose head scarf, a *duppata* or wroth cloth over their shoulders and a big stall, a petticoat, and ornamented bodices, a *sari* and a woollen cloth thrown over the head, constitute a woman's dress. Men and women tattoo their bodies and limbs and the women decorate themselves with big silver ornaments; women frequent the markets, and sell wool and ghee and are a pleasant sight in weekly markets and fairs. Cows, buffaloes and goats constitute their herd while camels are kept for transport. Most of their customs are Hindu. On the sixth day after birth, the goddess of fertility Shasti is worshipped, the name is given on the 15th day and the Brahmin officiates in their marriage, which takes place in the temple; unlike the high caste, the Rabari practise widow remarriage and allow divorce while polygyny is recognised as indicative of the status of the husband.

48. *Rajput*.—The Rajput are found all over Gujarat and Saurashtra. They are divided into several clans which are exogamous but commensal. The important clans are Chaowdas, Chauhans, Gohills, Jethwars, Jhalars, Parmals, Rathuars, Sisodia, Solunki and Waghalas. The Rajputs of Gujarat are usually tall, but not very tall, well built and fair, the noses high and straight, eyes large and dark, the mouth small, and the face oval. Usually the men wear large hair which is pasted within the middle to distinguish as they tell you from muslims. Women are handsome, fond of outdoor life, and walk in dignity. They speak Gujarati and understand Hindi. The Rajput always like to live in big houses which if they cannot afford they make mud-walls and thatch the roof. Some parts of their house must have tiled roof. The Rajput and Kathi are fond of decoration and their sitting room is always neatly kept with furnitures, and their utensils richly made, quilt and covers, displayed in large glass almirahs. They also keep sword and shield though they may not use them. The Rajput is a landholder. He is called the Thakur in his village and lives in a distinctive house. His dress consists of a loosely rolled turban in red or white, a double breast waist-coat, a long coat with white sleeves and a pair of light breeches and pointed shoes. The women are elegantly dressed and some put on bodice with strips covering the back, also a scarf for head. The Rajput remember their martial role in Indian history, and remember with pride their valour and sacrifices; they are straightforward and frank, hospitable to a degree, fond of animal food, liquor and addicted to tobacco and opium. There is hardly anything in their religious life to distinguish them from other high caste Hindus.

49. *Sunni Bora*.—are a prosperous trading community in Bombay and other parts of the Presidency. A very large portion of the trade in western India is in their hands. They are today distributed in important centres of trade in India and many have immigrated outside India to Persian Gulf, the Mediterranean ports and to Africa. Their trade consists mainly of imports of foreign goods and they are expert dealers in them in English towns. They are a fair looking, peaceful and a law abiding community. They were Brahmins who, it is said, embraced Islam under the influence of the Arabs.

50. *Waghar*.—The Waghar are partly Hindus but chiefly muslims. They are strong, well built group of people who had probably a Rajput ancestry. The Hindu Waghar have the surnames Waghar, Bhatad, Dina, Gad, Hatal, Kara, Kor, Manik, and Sumania. They usually keep boards, and possess a flat face some of them are itinerant traders and vendors of foreign merchandise. They breed cattle and also are reputed sorcerers and exorcists. The Waghar legend says that Shri Krishna forced a demon into the earth while he was sorting in the Gomti near Dwarka. The first issue from the hollow made was a Waghar who resembled a buried demon. The Waghar are fine looking people with shallow white complexion, fine nose, high forehead, muscular and adventurous. Some of them carry beards pasted in the middle. The women are usually well built, handsome and graceful. They speak Cutchy or a foreign Gujarati. From the administrative point of view they are considerably dreaded for their restlessness and turbulence. They have often rebelled against the administration of Gyekwar and at least four times, they had to be suppressed between 1816-73 A.D. One of their leaders has been a legendary hero, he is Mulu Manak, who is said to have stood the onslaught of overwhelming armies of the State and even did not submit with 7 bullets in his stomach. They take to various occupation, they are fishermen, robbers, landholders, and lashkars. The muslim Waghars are sunni by faith while the Hindu are worshippers of Shri Krishna and Ramchandraj, the Lord of Dwarka.

51. *Meghwar*.—The Meghwar, who are included in miscellaneous group I and II are one of the scheduled or untouchable castes of Gujarat. The Meghwar, both men and women can hardly be distinguished from the lowest classes of craftsmen and peasants and speak Gujarati with an accent which probably give clue to their tribal origin. Their houses are generally quartered outside the village and they work as labourers and artisans in the mills and factories throughout Gujarat. Some of them do cultivate and are more detribalised than the Bhil and other less settled tribes. Their cultural life is similar to that represented by the lower agricultural castes and communities except that they have lot of superstition and dread for witchcraft. They engage brahmin in their ceremonies and festivals and worship Hanuman, Gunpati, Ram and Devi. They are for all practical purposes Hindus and call themselves as such. They are short statured and their complexion varies from dark to light brown, the women possessing fairer complexion than men.

52. *Parsi*.—The Parsi are a cultured and educated social group, Europeanised in their dress and normally exclusive in their relations. They are a prosperous business community with their institutions centred round Bombay. Speaking

about the hospitality of the Parsis, Kincaid (British Social Life in India, Lond. 1935, pp. 242) writes how the *paterfamilias* with rimless prince-nez would come hurrying out into the verandah to greet his guests with a low bow and lead them into the long drawing room with its rocking chairs ranged in a straight row, the enormous cut glass chandelier, the model of the Taj Mahal on a blackwood table, the glass cupboards full of English China, the dark oil paintings of ancestors and of Zoroaster in meditation. Some of the Parsis are fabulously rich, while others are indigent, the former have maintained their physical traits to a large extent, the latter have mixed indiscriminately, with the result that the two sections even do not inter-marry. The social distance obtained between the two sections, has been a headache for the community, and divergent views about their respective futures, are freely expressed by them. The standard of physical fitness among the rank and file has receded in recent years, and economic maladjustment appears to tell its tale on the general health of the Parsi as a group.

Writing about the Persians, Haddon (The Wanderings of Peoples, Cambridge, 1919, p.26) says, "From the Eur-Asian steppes came Proto-Nordics who became known to history as Medes and Persians but semitic migrations have modified the type of the latter as did incursions of tribes allied to the Turks. Some authorities such as Ripley, see in the dark, dolichocephalic Persians, especially the Lori a strong Mediterranean strain, while the Parsi are relatively blond dolichocephals, the 'Aryans' of many authors."

According to Deniker (The Races of Man, pp. 419-20) the Iranians possessed the main characters of the Assyroid race with admixture of Turkish elements in Persia and Turkey, Indo-Afghan elements in Afghanistan and Arab and Negroid elements in the South of Persia and Baluchistan. The Persians have been divided into three geographical groups, viz., the Tajik, the Hajemi and the Parsi. The Tajik spread beyond the frontiers of Persia into western Afghanistan, the North West of Baluchistan, Afghan Turkistan and Russian Turkistan as far as the Pamirs perhaps even beyond. They are brachycephalic (ceph. index 84.9) above the average height (169 cms.) and show traces of intermixture with the Turkish race. The Hajemi and in some measure the Parsi who are dolichocephalic (77.9 C. I.) and of average height (165 cms.) are of Indo-Afghan type (*Ibid*). The Parsis must have come into India after the destruction of the Sassanide Empire. The Parsi we have measured in Bombay were mostly employees of two big commercial firms whose cephalic index was found to average 82.16 which agrees with Ujfalvy who put it down as 82.

Raja Rajendra Lal Mitra in his classics on Indo Aryans Vol.2, Lond., 1881, wrote about the Parsi: "Among the Parsis, notwithstanding, their ancient and well advanced civilisation, that most primitive form of disposal of the dead still obtains. The persistency of custom has in their case, withstood the culture of many thousand years, the only change noticeable being the introduction of an enclosing wall in the neighbourhood of towns and cities." (p. 116.). 'The religious idea underlying the ceremonial rite is that exposure served to purify the remains,

by contact with the rays of the Sun.' (p. 117), which must be hygienic, but according to Mitra himself, the Parsis well knew the rite of burial, for in the Vendidad mention is made of it under the name of Nasuspaya, the term for burning being Nasuspachya (Farg. I.v.v, 13-17) (*Ibid*). Rules have also been laid down for the collection of the bones of persons who have died in wild places, and for the preservation in charned houses, called *Uzdans* in Zend and *Astodans* in Pehlavi. These facts says, Mitra, 'tend to prove that both exposure and burial were well known'. The Parsi have a light skin, medium to tall stature, broad head and fine nose, but there are Parsi who possess dark complexion, broad nose and longish head, as for example among the domiciled Parsi of Bilimora. Parsi speak Gujarati but it is superimposed on their Persian language.

STATISTICAL TREATMENT OF THE DATA

53. The present material consists of measurements of 13 physical characters relating to 2,606 individuals belonging to 24 different castes and tribal groups, taken by Dr. D. N. Majumdar. Particular care was taken by the measurer, to eliminate personal bias in the collection of the material. Of those 24 groups, Machhi and Kharwa have been combined to form one group and so too Waghar Hindu and Waghar Muslim. Bhil are shown as two groups one of Rajpipla and those of Panchmahal. This has been done on the basis of a *priori* information about the physical resemblance, in general of the sub-groups within a group and the correspondence of the means. It would appear from a scrutiny of the data that in case of the groups, Rajput, Bhangi, Bhatia, Machi-Kharwa, Rabari, Kunbi Pattidar, Mher, Audich Brahmin and the Parsi, measurements on one, or more individuals for some of the characters looked doubtful. Such individuals have been omitted from the analysis after careful scrutiny. Amongst the rest, however, the measurements on some of the individuals for certain characters were not available comparisons of which could not be made. No measurements were available for the two Bhil groups with respect to the characters, auricular height and sitting height.

54. An attempt has been made here to put before the anthropologist and those interested in the field the main problems before us and the statistical methods which are being employed in treating them. Attempt has also been made to present some of the broad inferences arrived at from a preliminary examination of the data which only have to be confirmed with the help of other more competent statistical techniques.

55. The first and perhaps the most important problem before the anthropologist is 'whether it is possible with the help of the physical measurements at our disposal to find out with a reasonable degree of accuracy, if the 24 castes and tribes under study belong to one and the same homogeneous group of population? If not, whether it is possible to divide the groups into a number of clusters such that groups within each cluster can be regarded to belong to one homogeneous population, that is, the groups within any particular cluster are more closely together than groups belonging to two different clusters. The problem naturally resolves itself into finding what are known as D^2 -statistics or the square of the generalised distance

for each pair of castes and tribes which alone could be used in dividing the groups into a number of clusters such that groups within any particular cluster have smaller generalised distance among themselves than groups belonging to two different clusters. And a closer examination of the D^2 -values for each pair of castes and tribes will provide us with all the desirable information regarding the inter-cluster relationship, *i.e.*, all information about the arrangement of the clusters in a particular order. For example, if there be three clusters, A, B and C, B will be more closely situated to cluster A than to cluster C if the square of the generalised distance between A and B be less than that between B and C.

56. Interlinked with the problem of D^2 -statistics is the problem of 'choice of characters' in fact the latter precedes the former. For it is well-known that the computational work on D^2 -statistics increases considerably with the increase in the number of characters under examination, and if this number exceeds a certain limit it may be almost impracticable to complete the analysis in the absence of suitable machines especially designed for the purpose. It is, therefore, essential that choice of a set of characters be first made and the values of the generalised distance or D^2 -statistics calculated only for such a set of characters. This is, however, a subject of great difficulty and has been engaging the attention of both the statistician on the one end and the anthropologist on the other for some time past. In a joint report * Professor P. C. Mahalanobis and Dr. D. N. Majumdar have already shown that only five characters out of a total of 12 characters would provide reliable information for the purpose of classification. It is obviously desirable that the characters should have high discrimination in the sense that differences between different groups would be large and statistically significant. Another point for consideration is that the characters should be as independent as possible, that is, should have as low correlations among themselves as possible. It would thus be seen that only after the selection of the suitable characters the computational work of D^2 -statistics could be taken up for such characters. The problem of the choice of characters would require in the first instance a broad and precise classification, *i.e.*, the division of the 24 groups into two or more clusters such that groups forming a cluster are sharply differentiated in respect of mean values from those forming another cluster. Only after this has been obtained is it possible to select the suitable set of characters that would best discriminate the clusters. We, therefore, require for this broad classification a preliminary examination of the mean values of the various castes and tribes for each character and next obtain suitable sets of characters that would best discriminate the clusters which, of course, would require the need of a convenient measure of the generalised divergence amongst the various castes in respect of a set of characters. It would thus be seen that our first and foremost problem is a careful preliminary examination of the mean values which could provide the basis for detailed statistical analysis and investigation.

57. An examination of the dispersion of mean measurements of the 24 castes and tribes has been made in respect of all the characters excepting weight which has been left out on grounds of comparatively less reliability of measurement. An

* Sankhya, vol. 9, parts 2 and 3, March 1949.

attempt has been made to find out clusters of castes and tribes in respect of measurements of each character, and in this we have been mostly guided by the well-known statistical principle that when an observed difference in mean measurements between any two castes for a character exceeds, three times the standard error of the difference of the measurements, this difference may for all practical purposes, be taken as real and significant and not due to any random causes. The standard error of a difference "d" between two means \bar{x}_1 and \bar{x}_2 whose standard errors are respectively $\varepsilon(\bar{x}_1)$ and $\varepsilon(\bar{x}_2)$ (say) is given by the formula

$$\varepsilon(d) = \pm \sqrt{\left\{ \varepsilon(\bar{x}_1) \right\}^2 + \left\{ \varepsilon(\bar{x}_2) \right\}^2} \dots\dots\dots (1)$$

where $\varepsilon(d)$ denotes the standard error of the differences d, on the hypothesis that the measurements of the various castes and tribes in respect of a character are uncorrelated and the castes may from this point of view be taken as practically independent of each other.

58. A preliminary examination of the frequency distribution of the characters* would reveal that with the exception of few groups, *e.g.*, Bhatia, Oswal Jain, Waghar (Hindus and Muslims) and Koli, the distributions for the majority of characters in respect of the remaining groups are approximately normal. In the case of even those groups for each such character for which the measurements are not generally normally distributed, it will be seen that normality is valid for nasal length, and nasal breadth. It will also be seen that except for the Bhatia and the Bhangi the sample size is fairly high in the case of the remaining groups. The distributions of the mean measurements for the characters in respect of these groups may, therefore, for all practical purposes be assumed to be of the normal type and the application of the t-test enumerated in the foregoing para may be considered valid.

- * 1. If $S_1^2, S_2^2, \dots, S_k^2$ are estimated variances for various castes and tribes in respect of a character and n_1, n_2, \dots, n_k the corresponding degrees of freedom then the statistics

$$\frac{\frac{1}{2} \left[N \log S^2 - \sum n_i \log S_i^2 \right]}{1 + \frac{1}{3(K-1)} \left[\sum \frac{1}{n_i} - \frac{1}{N} \right]} \quad \text{where } S^2 = \frac{\sum n_i S_i^2}{N} \text{ and } N = \sum n_i$$

is distributed as chi-square with k-1 degrees of freedom, where k is the total number of castes and tribes analysed.

2. If X_1, X_2 be the estimate of mean measurements S_1, S_2 , be the estimates of the corresponding standard deviation n_1, n_2 the corresponding degrees of freedom, then the difference $\bar{x}_1 - \bar{x}_2$, is just judged to be significant, if it exceeds $d \sqrt{s_1^2 + s_2^2}$ where the value of d for each level of significance can be obtained from the table given by Dr. P. V. Sukhatme (Statistical Tables Fisher -Yates No. V₁ and V₂) given the three known values of n_1, n_2 , and O.

59. Strictly speaking, the application of formula (1) to test the difference between any two mean measurements is valid only on the assumption that the variances corresponding to the means are of the same order, *i.e.*, do not differ significantly between themselves. Accordingly the equality of the variances of the various castes and tribes for each character was first tested by Bartlett's test¹ by utilizing values of standard deviations for each character and each caste given in Table 2. It revealed that with the exception of a few characters, Bigonial breadth, Nasal length, Total facial length (facial length, significant at 5 per cent. level), and stature for which the variances are practically of the same order for different castes and tribes, the variances of the various castes and tribes for each of the remaining characters are significantly different from one another. In the case of the latter set of characters for which the material was found heterogeneous from variance point of view the equality of the variances for any two castes and tribes one from each of the two distinct cluster was tested by the variance ratio test (statistical Table V, Fisher and Yates-Variance Ratio) and in case where the variances were found significantly different from each other, the corresponding difference in mean measurements was tested by Behren's t-test² which takes into account the inequality of the variances corresponding to the mean measurements. The conclusions regarding the significant difference in the mean measurements in respect of each character between any two castes and tribes belonging to the distinct clusters obtained by this test only confirmed the results in these cases obtained by the Fisher's t-test.

We now proceed to study the mean measurement of the various castes and tribes (Table 1) in respect of each character.

60. *Maximum Head Length.*—From the mean maximum head measurements it appears that there is a progressive lengthening of the head as we proceed from the Bhil (179.60 ± 0.39), Bhangi (179.60 ± 0.88) and Bhil (179.60 ± 0.52) (which have the same head length,) to the groups Machi-Kharwa (183.07 ± 0.48), Mher (183.27 ± 0.59), Kunbi Pattidar (183.70 ± 0.63), Waghar Hindu and Muslim (183.82 ± 0.63), Audich Brahmin (184.15 ± 0.69), Luhana (184.17 ± 0.57), Memon (184.22 ± 0.66), Nagar Brahmin (184.27 ± 0.65), Khoja (184.57 ± 0.56), Rajput (185.03 ± 0.62), Bhatia (185.06 ± 1.38) and Parsi (185.25 ± 0.55) arranged in an ascending order of mean measurement. It would thus be seen that the Bhil, Bhangi, and Bhil and others are lowest on the scale of measurement as against the Rajput, the Bhatia and the Parsi which occupy the highest positions.

It would be seen that two sets of groups the (Bhil, Bhangi, Bhil and others) and (Luhana, Memon, Audich Brahmin, Khoja, Nagar Brahmin, Bhatia, Rajput, Parsi, Kunbi Pattidar, Mher, Machi Kharwa, Waghar Hindu and Waghar Muslims) form two distinct clusters such that there are no significant differences in mean maximum head length between any two groups within the clusters, but groups of one cluster differ significantly in mean measurement from any group of the other. It would further be seen that there are no significant variations in mean maximum head length between any two groups within each of the three sets of groups, (Bhil, Bhangi, Bhil and others, Miana, Koli, Bhadela, Miscellaneous Group II, Rabari, Oswal Jain, Artisans, Miscellaneous Group I, Sunni Bora, Machi Kharwa, Mher and Kunbi Pattidar) and (Machi-Kharwa, Mher, Kunbi Pattidar, Waghar

Hindus and Waghar Muslims) Luhana, Memons, Audich Brahmins, Nagar Brahmins, Khoja, Rajput, Bhatia and Parsi which may be regarded as a set of overlapping clusters such that there are groups common to any two adjoining clusters. The two sets of groups Koli (180.70 ± 0.62), Bhadela (180.84 ± 0.86), Miscellaneous Group II ($181.06 \pm .63$), Rabari ($181.19 \pm .71$), Oswal Jain (181.35 ± 0.67), Artisans ($181.40 \pm .56$) and Luhana ($184.17 \pm .57$), Memon ($184.22 \pm .66$), Audich Brahmin ($184.15 \pm .69$) and Nagar Brahmin ($184.27 \pm .65$) may again be regarded as forming two distinct clusters such that there are no variations between any two groups within a cluster but a group of one cluster differs significantly from a group of the other. It follows, therefore, that each of the groups Luhana, Memons, Audich Brahmin and Nagar Brahmin amongst which there are no significant variations differs significantly from each of the groups Bhil, Bhangi Bhil and others, Koli, Bhadela, Miscellaneous Group II, Oswal Jain, Artisans, and Rabari, which again form a constellation by themselves.

61. *Maximum Head Breadth*.—An examination of mean maximum head breadth would reveal that the mean head breadth for the groups Bhil (136.70 ± 0.28), Bhangi ($137.60 \pm .73$), Bhil and others (135.80 ± 0.41), are less than those of Koli (139.70 ± 0.50), Miscellaneous group I (140.01 ± 0.46), Artisan ($141.00 \pm .42$), Machi Kharwa ($142.42 \pm .54$), Misc. groups II ($143.30 \pm .63$), Kunbi Pattidar (143.27 ± 0.69), Audich Brahmin ($143.58 \pm .62$), Oswal Jain ($144.22 \pm .46$), Rajput ($144.55 \pm .54$) Mher (145.34 ± 0.53), Rabari (145.44 ± 0.64), Waghar Hindu and Waghar Muslim (145.65 ± 0.64), Sunni Bora ($146.00 \pm .65$), Luhana ($146.33 \pm .051$), Nagar Brahmin ($146.66 \pm .59$), Memon (147.07 ± 0.61), Khoja ($147.57 \pm .64$), Miana (148.60 ± 0.69), Bhadela ($151.47 \pm .62$), Parsi ($152.78 \pm .56$), and Bhatia (153.43 ± 1.04), the latter being arranged in ascending order of mean measurement. It would thus be seen that the Bhatia have the highest mean head breadth (153.43 ± 1.04), then come the Parsi ($152.78 \pm .56$), followed by Bhadela ($151.47 \pm .62$) and Miana (148.60 ± 0.69); the lowest on the scale being Bhil and others (135.80 ± 0.41).

It would be seen that the groups Bhil, Miscellaneous group I and Bhil and others which are lowest on the scale form a cluster distinctly different from the rest of the groups excepting Koli, and Miscellaneous group I and widely separated from the set (Bhatia, Parsi and Bhadela) which occupy the highest position on the scale and which do not differ amongst themselves.

It would further appear that there are no significant variations between any two groups within each of the three sets of groups (Koli, Miscellaneous group I, Artisans), (Machi-Kharwa, Miscellaneous group II, Kunbi Pattidar, Audich Brahmin, Oswal Jain, Rajput) and (Mher, Rabari, Waghar Hindu and Muslim Sunni Bora, Luhana, Nagar Brahmin, Memon and Khoja) which may, therefore, for all practical purposes be regarded as three constellations.

An examination of mean measurements of maximum head breadth would further reveal that every member of the constellation, Koli, Miscellaneous group I and Artisans, differ significantly from every member of the constellation Mher, Rabari, Waghar Hindu and Waghar Muslim, Sunni Bora, Luhana, Nagar Brahmin, Memon, and Khoja, and of course from every member of the set Bhatia, Parsi and Bhadela.

62. To sum up, each of the sets of groups (Bhil, Bhil and others, Bhangi) and (Koli, Miscellaneous group I, Artisans) within which there are no variations differ significantly in respect of head breadth, from each of the groups, Mher, Rabari, Waghar Hindu and Waghar Muslim, Sunni Bora, Luhana, Nagar Brahmin, Memon, Khoja, Miana, Bhadela, Parsi and Bhatia; also there are no significant differences between any member of the set Bhil, Bhil and others, Bhangi and any member of Koli and Miscellaneous group I.

Thus, every member of the set (Bhil, Bhil and others Bhangi, Koli, Miscellaneous group I) differs significantly from every member of the set (Mher, Rabari Waghar Hindu and Waghar Muslim, Sunni Bora, Luhana, Nagar Brahmin, Memon, Khoja, Miana, Bhadela, Parsi and Bhatia, there being no significant difference between any two groups of the set Bhil, Bhil and others, Bhangi, Koli and Miscellaneous group I. The Bhatia which occupy the highest position on the scale may be regarded as an isolated group distinctly different from the rest except Bhadela and Parsi which seem akin to it in respect of maximum head breadth.

63. *Minimum Frontal Breadth.*—It is interesting to note that the behaviour of groups Bhil (101.90 ± 0.17), Bhangi ($101.22 \pm .76$) and Bhil and others ($100.70 \pm .35$) in the case of minimum frontal breadth are similar to those in case of the previous two characters. The groups form a constellation by themselves and occupy the lowest position on the scale, situated far remote from the groups Nagar Brahmin ($106.95 \pm .36$), Khoja ($107.33 \pm .43$), Miana, ($107.52 \pm .47$), Bhatia ($107.65 \pm .0.80$), Bhadela ($108.18 \pm .0.58$) and Parsi ($109.41 \pm .37$) arranged in ascending order of magnitude. The latter set again forms a constellation by themselves excepting the Parsi ($109.41 \pm .37$) which occupy the highest position on the scale, as against Bhil and others ($100.70 \pm .35$) which are lowest on the scale. It would also be seen that every member of the set of groups Bhil ($101.90 \pm .17$), Bhil and others ($100.70 \pm .35$) and Bhangi ($101.22 \pm .76$) differ significantly from every member of the set Sunni Bora ($104.80 \pm .40$), Machhi-Kharwa ($105.14 \pm .37$), Rajput ($105.34 \pm .48$), Waghar Hindu and Waghar Muslim ($105.70 \pm .40$), Audich Brahmin ($106.04 \pm .48$), Rabari ($105.97 \pm .42$), Oswal Jain ($106.07 \pm .43$), Luhana ($106.41 \pm .42$), Memon ($106.46 \pm .42$), Kunbi Pattidar ($106.60 \pm .43$) and Mher ($106.91 \pm .43$) arranged in ascending order of measurement, there being no significant difference in measurements between any two groups belonging to the latter set. Thus the set of groups (Bhil, Bhil and others and Bhangi) forms with the set of groups (Nagar Brahmin, Khoja, Miana, Bhatia, Bhadela) and also with the set (Sunni Bora, Machi Kharwa, Rajput, Waghar Hindu and Waghar Muslim, Rabaris, Oswal Jain, Audich Brahmin, Luhana, Memon, Kunbi Pattidar and Mher), two sets of distinct clusters, the latter set of groups being intermediate to the first two sets on the scale of measurement.

It would further be seen that although there are no significant variations in mean measurement between any two groups of the set Koli ($104.10 \pm .37$), Artisan ($103.70 \pm .36$), Miscellaneous group I ($103.20 \pm .33$), and Miscellaneous groups II ($104.28 \pm .40$) every member of the set differs significantly in mean frontal breadth from every member of the set (Nagar Brahmin, Khoja, Miana, Bhatia and Bhadela) which as we have seen form a separate constellation by themselves.

It would also appear that the three sets of groups (Miscellaneous group I, Miscellaneous group II, Koli, Artisan), (Artisan, Koli, Miscellaneous groups II, Sunni Bora, Machi Kharwa, Rajput) and (Sunni Bora, Machi Kharwa, Rajput, Waghar Hindu and Waghar Muslim, Rabaris, Oswal Jains, Audich Brahmins, Luhana, Memon, Kunbi Pattidar, and Mher) form three overlapping clusters such that there are no variations between any two groups within a cluster but there are groups common to any two adjoining clusters. These three clusters occupy an intermediate position between the two extreme clusters (Bhil, Bhil and others, Bhangi) and (Nagar Brahmin, Khoja, Miana, Bhatia and Badela).

To sum up, the two compact sets of groups (Bhil, Bhil and others, Bhangi) and (Miscellaneous group I, Miscellaneous group II, Koli and Artisan) which stand low on the scale of measurement seem to be more affiliated to each other and situated far remote from the groups (Nagar Brahmin, Khoja, Miana, Bhatia, Bhadela and Parsi) which are on the other extreme of the scale. The Parsi which have the highest mean measurement differ significantly from the remaining groups excepting Bhadela and Bhatia.

64. *Maximum Bizygomatic Breadth.*—It would be seen that the configuration of clusters more or less remains the same in the case of Bizygomatic measurement. The groups Bhil, Bhil and others, and Bhangi do not differ significantly amongst themselves and thus form a cluster, which occupies the lowest positions on the scale, the highest being for the set of groups Khoja, Mher, Bhatia, Bhadela and Parsi, there being no significant difference in mean measurement amongst the latter set. The Parsi have the highest mean measurement (138.11 ± 0.52) and the Bhil and Bhil and others the lowest, being respectively ($128.40 \pm .02.27$) and ($128.40 \pm .38$).

It would also be seen that the groups (Bhil, Bhil and others, Bhangi) and Machi-Kharwa, Nagar Brahmin, Audich Brahmin, Rajput, Sunni Bora, Rabari, Waghar Hindu and Waghar Muslim, Kunbi Pattidar, Luhana, Oswal Jain, Miana, Memon arranged in ascending order of measurement form two distinct clusters such that there are no significant variation between any two groups within a cluster but every member of one cluster differs significantly from every member of the other. Thus every member of the cluster Bhils, Bhil and others, and Bhangi differ significantly from every member of each of the two clusters (Machi Kharwa, Nagar Brahmin, Audich Brahmin, Rajput, Sunni Bora, Rabari, Waghar Hindu and Waghar Muslim, Kunbi Pattidar, Luhana, Oswal Jains, Miana, Memon) and (Khoja, Mher, Bhatia, Bhadela and Parsi). It would further be seen that every member of the set of groups Koli, Artisans, Miscellaneous group I and Miscellaneous groups II, which form a cluster situated intermediate between the two clusters (Bhil, Bhil and others, Bhangi) and (Machi Kharwa, Nagar Brahmin, Audich Brahmin, Rajput, Sunni Bora, Rabari, Waghar Hindu and Waghar Muslim, Kunbi Pattidar, Luhana, Oswal Jain, Memons and Miana) is significantly different from very member of the cluster (Khoja, Mher, Bhatia, Bhadela and Parsi).

It would thus be seen that the set [Bhil, Bhil (and) others and Bhangi] seem closely affiliated to the set (Koli, Miscellaneous group I, Artisans and Miscellaneous group II), but every member of the two sets taken together differs

significantly from every member of the set (Khoja, Mher, Bhatia, Bhadela, and Parsi), a fact which has been more or less observed in case of maximum head length, maximum head breadth and minimum frontal breadth.

65. *Bigonial Breadth*.—The mean Bigonial breadth measurements have practically the same tale to toll. Here again the Bhil (97.30 ± 0.39) stand lowest on the scale of measurement, next in order are Bhils and others (99.20 ± 0.47) and Bhangi (99.70 ± 0.83) as against Mher (105.48 ± 0.50) which are on the other extremity of the scale.

It would be seen that the groups Bhil, Bhil and others and Bhangi which for all practical purposes form a cluster (except for Bhil, Bhil and others which differ significantly from each other in respect of mean measurement) are situated far remote from the cluster of groups. Khoja (103.89 ± 0.55), Parsis ($103.95 \pm .57$), Memon ($104.14 \pm .55$), Bhatia (104.31 ± 1.06), Luhana ($104.34 \pm .53$), Waghar Hindu and Waghar Muslim ($104.52 \pm .55$), Oswal Jain ($104.93 \pm .54$) Mher ($105.48 \pm .50$), Miana ($105.78 \pm .78$) and Bhadela ($105.90 \pm .79$) arranged in ascending order of mean measurement, such that although there is no significant difference between any two groups within the latter cluster, every member of this cluster differs significantly from each of the groups Bhil, Bhil and others and Bhangi in respect of mean measurement.

It would further be seen that every member of the set of groups, Koli, Artisans, Miscellaneous group I and Miscellaneous group II, which do not differ significantly amongst themselves and occupies an intermediate position between the two clusters discussed above, differs significantly from every member of the set Oswal Jain Mher, Miana and Bhadela, which as has been seen occupy the highest position on the scale of measurement and do not differ significantly amongst themselves. Thus each of the two sets of groups, (Bhil, Bhangi, Bhil and others) and (Koli, Artisans, Miscellaneous group I and Miscellaneous group II), which are rather closely situated differ significantly from the set (Oswal Jain, Mher, Miana and Bhadela) in respect of mean Bigonial breadth.

66. *Nasal Length*.—An examination of mean length would reveal that the Bhil and others have the lowest mean Nasal length (47.80 ± 0.31), the Rabari (52.55 ± 0.31), Mher (52.60 ± 0.35), Khoja (53.00 ± 0.34), the Memon (53.39 ± 0.38), and the Parsi ($54.60 \pm .30$), possess longer nose, the longest being for the Parsi. It would be seen that the groups (Bhil, Bhil and others, Koli, Artisan, Bhangi) and (Rabari, Mher, Khoja, Memon), form two distinct clusters such that whilst there is no significant variation between any two groups within each of the clusters, a group of one cluster differs significantly from a group of the other. Also, every member of the set Bhil ($47.86 \pm .24$), Bhil and others ($47.80 \pm .31$), Koli ($48.80 \pm .25$), and Artisan ($48.89 \pm .27$), differ significantly from every member of Sunni Bora ($51.30 \pm .35$), Nagar Brahmin ($51.38 \pm .34$), Kunbi Pattidar ($51.40 \pm .34$), Audich Brahmin ($51.44 \pm .30$), Luhana ($51.50 \pm .27$), Bhadela ($51.51 \pm .37$), Miana ($51.52 \pm .42$), Waghar Hindu and Waghar Muslim ($51.70 \pm .29$), Bhatia ($51.86 \pm .65$), Rajput ($51.98 \pm .29$), Rabari ($52.55 \pm .31$) and Mher ($52.60 \pm .35$),

arranged in ascending order, there being no significant difference between any two groups belonging to the latter set. Thus the (Bhil, Bhangi, Bhil and others, Koli, Artisan), and (Rabari, Mher, Khoja and Memon), form two distinct clusters and of the rest of the group the Sunni Bora, Kunbi Pattidar, Audich Brahmin, Nagar Brahmin, Miana, Luhana, Bhadela, Waghar Muslim and Waghar Hindu, Bhatia, and Rajput are nearer to the latter set and, therefore, akin to it, the remaining groups, Oswal Jain, Machi-Kharwa, Miscellaneous Groups I and II being closer to the former set, Bhil, Bhil and others, Bhangi, Koli and Artisans. It would also be seen that the Parsi form a distinct group significantly higher in mean measurement from the rest of the castes and tribes excepting the Memon.

67. *Nasal Breadth*.—The configuration of the cluster seem to have been somewhat disturbed in the case of mean Nasal breadth, the Rajput occupying the lowest mean breadth ($35.60 \pm .25$) instead of any of the groups Bhil, Bhangi and Bhil and others as was observed in the discussion in the foregoing pages which though not lowest on the scale, occupy a slightly higher position and are closely together, the highest mean value being given by Kunbi Pattidar (38.70 ± 0.28). It would be seen that the groups, Sunni Boras ($36.08 \pm .42$), Rabari (36.40 ± 0.23), Memon ($36.45 \pm .27$), Bhil (36.60 ± 0.18) and Koli ($36.70 \pm .19$) arranged in ascending order of measurement form a constellation by themselves, and occupy a very low position on the scale, every member of the constellation differing significantly from every member of the set Bhatia (38.16 ± 0.43), Oswal Jain ($38.30 \pm .24$) and Kunbi Pattidar (38.70 ± 0.28) amongst which there are no significant differences and which occupy the highest position on the scale. The set of groups, Audich Brahmin (36.75 ± 0.35), Miana ($36.78 \pm .29$), Waghar Hindu and Waghar Muslim ($36.83 \pm .23$), Nagar Brahmin ($36.88 \pm .25$), Parsi ($36.95 \pm .24$), Artisan ($36.99 \pm .19$), Luhana (36.99 ± 0.20), Bhangi ($37.02 \pm .40$), Miscellaneous group II ($37.03 \pm .28$), Bhil and others ($37.15 \pm .24$), Mher ($37.24 \pm .21$), Khoja ($37.27 \pm .24$), and Machi Kharwa ($37.31 \pm .19$) and Miscellaneous group I ($37.38 \pm .17$), arranged in ascending order of measurement intermediate between the two extreme sets enumerated above, are lower on the scale and nearer to the set (Sunni Bora, Rabari, Memon, Bhil and Koli). The Bhadela ($37.88 \pm .30$), which are also intermediate between the same two sets are nearer to the other extreme cluster (Bhatia, Oswal Jain and Kunbi Pattidar) and thus more akin to it.

68. *Total Facial Length*.—In total facial length, the Koli have the lowest mean length (107.90 ± 0.52) and Miana, the highest (115.12 ± 0.87). There are significant variations amongst the groups Bhangi (109.07 ± 0.85), Artisans (109.09 ± 0.47), Bhil (109.40 ± 0.41), Miscellaneous group I (109.76 ± 0.52), Bhil and others (109.87 ± 0.58), Nagar Brahmin (110.50 ± 0.58), Miscellaneous group II (110.56 ± 0.66), and Machi-Kharwa (110.99 ± 0.46), which stand lowest on the scale and arranged in ascending order of measurement, although every member of the set, differs significantly from every member of the set Parsi (114.70 ± 0.33), Waghar Hindus and Waghar Muslim (114.71 ± 0.34), Rabari (114.75 ± 0.63), Khoja (114.80 ± 0.65), Bhadela ($114.82 \pm .68$), and Miana (115.12 ± 0.87) which again form a cluster by themselves. The remaining groups are intermediate to the two extreme sets and of these the Kunbi Pattidar (111.20 ± 0.55), the Bhatia (111.36 ± 1.30), and

Oswal Jain (111.66 ± 0.55) are nearer to the former set than the latter being situated low on the scale, there being no significant difference amongst the groups Miscellaneous group I, Bhil and others, Nagar Brahmin, Miscellaneous group II, Machi Kharwas, Kunbi Pattidars, Audich Brahmins, Bhatia, and Oswal Jain. The set of groups Rajputs ($112.84 \pm .57$), Sunni Bora (113.40 ± 0.56), Mher (113.89 ± 0.45) and Memon ($113.70 \pm .61$) have, however, higher means measurements but do not differ significantly from any member of the set Parsi (114.70 ± 0.33), Waghar Hindus and Waghar Muslim (114.71 ± 0.34), Rabari (114.75 ± 0.63), Khoja (114.80 ± 0.65), Bhadela (114.82 ± 0.68), Miana ($115.12 \pm .87$), and the two may be regarded as forming a type in respect of mean total facial length. Thus in respect of mean total facial length, the total number of groups can be broadly divided into two sets *i.e.*, (the Koli, the Artisan, the Bhil, the Bhangi, Miscellaneous Group I, Bhil and others, Nagar Brahmin, Miscellaneous group II, the Machi-Kharwa, the Kunbi Pattidar, Audich Brahmin, Bhatia, the Oswal Jain) and (the Luhana, the Rajput, the Sunni Bora, the Memon, the Mher, the Parsi, the Waghar Muslim and Waghar Hindu, the Rabari, the Bhadela, the Khoja, the Miana), such that any two groups within a set are more closely together than any two from two different sets.

69. *Upper Facial Length*.—It would appear from an examination of the mean measurements that the two sets of groups Artisans ($58.38 \pm .35$), Miscellaneous group I ($58.51 \pm .34$), Bhil and others ($58.90 \pm .39$), Machi-Kharwa ($59.52 \pm .34$), Miscellaneous group II ($59.66 \pm .43$), Bhil ($59.69 \pm .31$), and Oswal Jain ($62.20 \pm .37$), Bhadela ($62.22 \pm .38$), Luhana ($62.20 \pm .34$), Mher ($62.40 \pm .38$), Rabari ($62.46 \pm .39$), Memon ($62.80 \pm .48$), Waghar Hindu and Waghar Muslim ($63.41 \pm .54$), Miana ($63.67 \pm .55$), Parsi ($63.52 \pm .34$), Bhatia ($63.76 \pm .75$) form two distinct clusters, situated almost at the extreme ends of the scale and arranged in ascending order of measurement such that although there are no significant variations between any two groups within a cluster, a group of one cluster differs significantly from a group of the other. The Bhangi have the lowest mean measurement ($57.26 \pm .63$), and the Khoja the highest ($64.06 \pm .40$). Amongst the intermediate groups, the Kunbi Pattidar, the Rajput, the Sunni Bora, Audich Brahmin, the Nagar Brahmin, which are not significantly different from each other, resemble more the latter cluster being nearer to it than the former. The Bhangi ($57.26 \pm .63$) and Koli ($57.30 \pm .35$) which have lowest mean measurements do not differ significantly from the groups Artisans ($58.38 \pm .35$), Miscellaneous group I ($58.51 \pm .34$), and Bhil and others ($58.90 \pm .39$), and, therefore, seem to be more mixed up with the groups belonging to the cluster (Artisans, Miscellaneous Group I, Bhil and others, Machi Kharwa, Miscellaneous group II, and Bhil. It would also be seen that the Kunbi Pattidar ($60.58 \pm .41$) and the Rajput ($60.81 \pm .45$) do not differ significantly in mean measurement, from each of the two sets of groups (Miscellaneous group II, Bhil, Machi-Kharwa) and (Luhana, Bhadela, Oswal Jain) although every member of one set differs so, from every member of the other. In this respect, therefore, the Rajput and Kunbi Pattidar are intermediate in type between the above two sets.

70. *Auricular Height*.—A glance at the table would show that the Bhangi have the lowest mean measurement ($12.19 \pm .10$) and the Parsi the highest ($13.34 \pm$

.06). It would also be seen that the Bhangi ($12.19 \pm .10$), the Artisan ($12.25 \pm .06$), the Koli ($12.41 \pm .05$), Miscellaneous group I ($12.46 \pm .05$), Oswal Jain ($12.47 \pm .07$) and Machi-Kharwa ($12.51 \pm .06$) arranged in ascending order of measurement form a compact set such that there are no variations between any two groups belonging to the set. Similarly there are no variation between any two groups of the set, Khoja ($12.89 \pm .05$), Waghar Muslim and Waghar Hindu (12.89 ± 0.07), Nagar Brahmin ($12.90 \pm .06$), Rabari ($12.92 \pm .07$), Miana ($12.92 \pm .08$), Sunni Bora ($12.93 \pm .07$), Memon ($12.97 \pm .07$), Mher (12.99 ± 0.08 , Audich Brahmin ($13.01 \pm .07$), Luhana ($13.20 \pm .13$), Rajput ($13.20 \pm .07$), Bhatia ($13.31 \pm .16$), and Parsi ($13.34 \pm .06$) arranged in increasing order of measurement. It is, however, interesting to note that every member of the first set differs from every member of the second, set, and the two sets behave as two distinct clusters in this respect. It would further be seen that Miscellaneous group II ($12.67 \pm .09$), Kunbi Pattidar ($12.73 \pm .06$) and Bhadela ($12.78 \pm .08$) are intermediate to the two sets, and of these the Kunbi Pattidar, and the Bhadela, which do not differ significantly from the Khoja, Waghar Muslim and Waghar Hindu, Nagar Brahmin, Rabari, Miana, Sunni Bora, Memon, Mher and Audich Brahmin, seem more mixed up with this set. Miscellaneous group II, is, however, nearer to the set Bhangi, Artisan, Koli, Miscellaneous group I, Oswal Jain, and Machi Kharwa in respect of mean measurement than the latter set.

It would be seen in general, that there are no striking significant differences amongst the groups and the groups form two compact clusters such that each cluster is an assemblage of a large number of groups. It would thus appear that the mean auricular height is not a very suitable character for use in the discrimination of groups.

71. *Stature*.—The Mher appear to be the tallest group with a mean stature of ($169.51 \pm .046$), next come the Rabari ($168.22 \pm .49$) and next in order are the Waghar Hindus and Waghar Muslims ($167.95 \pm .54$). The above three groups together with Parsi ($167.73 \pm .46$) and the Miana ($167.37 \pm .76$), which are next in stature to Waghar Muslims and Waghar Hindus do not differ significantly amongst themselves and seem to form a constellation by themselves. The Bhil have the shortest mean stature ($159.58 \pm .37$), next in order are the Machi Kharwas ($159.63 \pm .38$), Bhangi ($159.72 \pm .96$), Bhil and others ($160.05 \pm .52$) Miscellaneous group I ($160.37 \pm .58$), the Koli ($160.80 \pm .58$) and the Artisans ($161.31 \pm .53$), which form a cluster by themselves. Amongst the intermediate groups are the Sunni Bora ($162.90 \pm .52$) Miscellaneous group II ($163.50 \pm .54$) Memon ($163.72 \pm .52$), Nagar Brahmin ($163.73 \pm .56$), Oswal Jain ($163.98 \pm .58$), Kunbi Pattidar ($164.20 \pm .57$), Rajput ($164.33 \pm .53$), Audich Brahmin ($164.34 \pm .73$), Khoja ($164.53 \pm .59$), Luhana ($164.57 \pm .51$), Bhadela ($165.58 \pm .89$) and the Bhatia ($165.81 \pm .99$), arranged in ascending order of mean measurement and which also form a constellation in respect of the measurement. It would further be seen that except for the Koli, the Artisans, the Bhadela and the Bhatia, the three clusters are distinct, in that although there are no variations within each of the clusters, a group of one of these differs significantly from a group of the other. It would further be seen that the Bhatia and the Bhadela are nearer to the extreme constellation

formed by the Miana, Parsi, Waghar Hindu, and Waghar Muslim, the Rabari, and the Mher than to the cluster (Bhil, Machhi Kharwa, Bhangi, Bhil and other and Miscellaneous Group I).

72. *Sitting Height*.—An examination of the mean measurements would reveal that Machhi-Kharwa have the lowest sitting height (81.42 ± 0.26) next in order are the Koli (81.50 ± 0.26), the Artisans (81.59 ± 0.24), Miscellaneous group I (81.74 ± 0.30) and the Bhangi (82.03 ± 0.43) which do not show any significant variations among themselves and thus form a closely associated set. At the other extreme of the scale are the Nagar Brahmin (85.49 ± 0.32), the Mher (85.51 ± 0.34), the Bhadela (85.66 ± 0.44), Waghar Hindus and Muslims (85.68 ± 0.32), the Parsis (85.94 ± 0.25) and the Miana (86.03 ± 0.46) arranged in ascending order of mean measurement and forming a closely associated set. It would further be seen that every member of this cluster has a significantly higher mean sitting height than every member of the cluster (Machhi-Kharwa, Koli, Artisans, Miscellaneous group I, and the Bhangi) which stand lowest on the scale of measurement and also from every member of the intermediary cluster formed by the Miscellaneous group II (83.77 ± 0.31) Memon (83.87 ± 0.27) and the Kunbi Pattidar (83.95 ± 0.31), arranged in ascending order of mean measurements. Also, Machhi-Kharwa, Koli, Artisans, Miscellaneous group I, and the Bhangi, which form a closely affiliated set are significantly lower in mean measurement from every member of the set (Miscellaneous group II, Memon, Kunbi Pattidar, Oswal Jain, Audich Brahmin and Khoja), which together with the constellation Miscellaneous group II, Memon and Kunbi Pattidar, form two overlapping clusters with Miscellaneous group II, Kunbi Pattidar and Memon common to the two sets. Thus the three sets of groups (Machhi-Kharwa, Koli, Artisans, Miscellaneous Group I, Bhangi) and (Miscellaneous group II, Kunbi Pattidar and Memon), and (Nagar Brahmin, Mher, Waghar Hindus and Muslims, Bhadela, Parsi and Miana) form three distinct clusters such that groups within any cluster are closely alike but a group of one cluster differs significantly from a group of the other cluster. The Rajput (87.80 ± 0.27) form a distinct type by themselves with the highest mean measurement and differs significantly from the rest of the groups.

73. We next proceed to study the coefficient of variation for each character and for each caste or tribe and obtain characters which are suitable for the purpose *i.e.*, characters for which the co-efficient of variation for the castes and tribes are not very high, and, thus, the mean measurements for the respective castes and tribes fairly reliable. In table 3 are presented the co-efficient of variation with their standard errors for each character and for each caste or tribe. It would appear from the table that in the case of maximum head length the coefficient of variation is least for Khoja (3.06 per cent) and maximum for the Bhatia (4.08 per cent) the latter being based on a comparatively smaller number of measurements. In case of maximum head breadth, it ranges between 2.94 per cent (Bhadela) and 4.78 per cent. (Kunbi Pattidar). In case of minimum frontal breadth the Bhil have the lowest co-efficient of variation (2.48 per cent) and Bhangi the highest (4.80 per cent.), the co-efficient of variations for the remaining castes and tribes being intermediate between the two extremes. The range in case of maximum bizygomatic breadth

is between 2.82 per cent (Miana) and 5.34 per cent (Bhadela). In case of bigonial breadth the Parsi have the highest co-efficient of variation (6.40 per cent) and Machi Kharwa the lowest (4.59 per cent). The co-efficient of variation in case of nasal length ranges between 5.16 and 9.06 per cent. being respectively for the Bhadela and the Bhangi, the variations for the rest of the castes and tribes lying between these two values. In case of nasal breadth the Sunni Bora have an unusually high co-efficient of variation being about 11.84 per cent due to considerable heterogeneity of the material the lowest figure being for Miscellaneous group I (5.37 per cent). The range of variation in case of total facial length is 3.41—6.39 per cent. being respectively for the Parsi and the Bhatia which is an usual based on a smaller number of measurements. The Sunni Bora have the least co-efficient of variation in case of upper facial length being 3.73 per cent. and the Memon the maximum being 7.55 per cent. In case of auricular height the lowest co-efficient of variation is for the Khoja 4.07 per cent. and the highest is for Luhana which have a variation as high as 11.49 per cent. The co-efficient of variation in case of stature ranges between 2.74 and 4.27 per cent approximately these being respectively for the groups Mher and Miscellaneous group I. In case of sitting height the range is between 3.03 and 6.28 per cent. these being respectively for the groups Luhana and Sunni Bora.

74. It would thus be seen that the co-efficient of variation is below 4 per cent, in case of maximum head length, below 5 per cent. in case of maximum head breadth minimum frontal breadth and stature, below 7 per cent. in case of maximum bizygomatic breadth, bigonial breadth, total facial length, below 9 per cent. in case of nasal length, upper facial length, and below 12 per cent. in case of nasal breadth and auricular height. Thus, in the case of the last two characters, the co-efficient of variations are fairly high, showing that the material is heterogeneous and, therefore, a larger number of measurements will have to be taken on the various castes and tribes to attain a desired degree of reliability compared to such characters as maximum head length, maximum head breadth, minimum frontal breadth for which the co-efficients of variations are reasonably low.

75. In the preceding pages we have made an intra and intercluster study of the various castes and tribes in respect of each character and have tried to assess the relative reliability of measurements of the characters. We now proceed to sum up the position as under :—

It would appear that the Bhil, Bhangi, and Bhil and others generally occupy the lowest position on the scale of measurement and in particular for the characters, maximum head length, maximum head breadth, minimum frontal breadth, maximum bizygomatic breadth, bigonial breadth, nasal length, total facial length, upper facial length and for stature. Next in order of measurement and closely affiliated to the above cluster seem to be the Artisans, Koli, Miscellaneous group I, Miscellaneous group II and Machhi-Kharwa. It would further be seen that of the latter set, the Artisans, Miscellaneous group I and Koli form a more stable cluster and closely alike in respect of all the characters excepting total facial length and upper facial length, for which the Kolis show a slightly different behaviour from other groups of the set. It would also be seen that there are no significant differences amongst the groups

Artisans, Miscellaneous groups I and II, Koli, and Machhi-Kharwa in respect of the characters maximum head length and nasal breadth. The Artisans, Koli, Miscellaneous groups I and II form a closely associated set in respect of the characters maximum head length, minimum frontal breadth, maximum bizygomatic breadth and nasal breadth; and the Artisans, Koli, Miscellaneous group I and the Machhi-Kharwa resemble one another in respect of the characters, auricular height, stature, sitting height, nasal breadth, nasal length and maximum head length.

76. On the other end of the scale and far remote from the main cluster we have the Parsi, and Bhatia, which are situated close to each other and do not show any significant difference in mean measurements in the case of all the characters excepting minimum frontal breadth, total facial length and nasal length. Slightly displaced from the above groups and closely associated with these are placed Mher, Miana, Waghar Muslims and Hindus and the Bhatia which do not show any difference in mean measurements except in maximum head length, maximum head breadth and maximum bizygomatic breadth. It would also be seen that the Parsi, Bhatia Mher, Miana and the Waghar Muslims and Hindus do not show any significant differences in mean measurements in the case of the characters bigonial breadth, sitting height, auricular height and upper facial length and of these the Parsi, Bhatia and Mher form a more stable set and do not show any significant difference in mean measurements in the case of the characters bigonial breadth, sitting height, auricular height and upper facial length and of these the Parsi, Bhatia and Mher form a more stable set and do not show any significant difference in mean measurements in the case of characters maximum head length, sitting height, stature, auricular height, upper facial length, bigonial breadth and maximum bizygomatic breadth. Next in order and somewhat displaced from the above clusters we have the Luhana, Memon, Khoja, Nagar Brahmin and the Audich Brahmin, which form a closely compact set in respect of the characters maximum head length, minimum frontal breadth, sitting height, stature, auricular height, nasal breadth, and maximum bizygomatic breadth. The Rabari seem to be affiliated with the above cluster in respect of all the above characters excepting maximum head length and stature.

77. Somewhat lower on the scale and yet situated nearer to the groups Parsi, and Bhatia, occur the Kunbi Pattidar, Sunni Bora and Rajput which generally form a cluster by themselves particularly in case of the characters minimum frontal breadth, stature, upper facial length, total facial length, nasal length and maximum bizygomatic breadth. The Oswal Jain follow closely the above set in all the above characters excepting nasal length.

78. It may now be worthwhile to find out how far our tentative conclusions reached by comparison of single measurements are supported by the co-efficient of Racial Likeness Method, a technique which has its limitations as pointed out by Prof. R. A. Fisher. The C.R.L. may be taken as a generalised measure of resemblance though in the words of Fisher, 'it does not take into account the correlation and covariation of different measurements but treats them as though they were statistically independent and thus is not very reliable as a test of significance.' Accepting the status of the tool as such, we have, however, tried to keep in view the requirements that the characters chosen for the purpose should, as far as possible,

be independent of each other. This indeed is difficult to maintain, as the characters must be correlated in some manner or the other as they are parts of the same individual yet there must be degrees of correlation and the characters chosen for comparison have the merit of being stable in the anthropometric sense. In this of course we have been guided mainly by our observations on the indefinite characters and appearance in general, and not statistical data laboriously computed in connection with correlation analysis.

79. Of the twelve physical characters for which investigations have been made individually, only nine have been chosen for the calculation of reduced C.R.L. The characters omitted being 1. nasal breadth, 2. upper facial length and 3. auricular height. The characters, auricular height and nasal breadth have been omitted owing to a high co-efficient of variation in respect of various castes and tribes. The character total facial length was included but upper facial length was not, as the two are very highly correlated, since the latter practically forms part of the former. We are thus left with nine characters only, a number, which is rather small, to provide results of more than provisional value, and it remains to be seen how the result arrived at from the analysis on the above line compare with those obtained from the application of D^2 Statistics.

80. The formula used for the calculation of the Reduced Co-efficient of Racial likenes and their standard errors is given by the expression—

$$50 \times \frac{\bar{n}_1 + \bar{n}_2}{\bar{n}_1 + \bar{n}_2} \left\{ \frac{1}{m} \sum (\alpha) - 1 \right\} \pm 50 \frac{\bar{n}_1 + \bar{n}_2}{\bar{n}_1 + \bar{n}_2} \times .67449 \sqrt{\frac{2}{m}}$$

where (α) stands for $\left\{ \frac{(Ms - M\bar{s})^2}{\frac{\sigma s^2}{ns} + \frac{\sigma \bar{s}^2}{n\bar{s}}} \right\}$

Ms , σs , ns are the mean, standard deviation, and number of individuals respectively for the first series and $M\bar{s}$, $\sigma \bar{s}$ and $n\bar{s}$ are the corresponding constants for the second series. m is the number of characters compared which in our case is 9. \bar{n}_1 is the mean number of individuals for whom the characters used in computing the co-efficients are recorded in the case of the first series and \bar{n}_2 is the same for the second series. For complete mathematical deduction of the formula please refer to the article by Dr. G. M. Morant, on the Physical Anthropology of the Swat & Hunza Valleys Based on Records collected by Sir Aurel Stein in the *Journal of the Royal Anthropological Institute*, Vol. LXVI, January—June 1936.

81. In table "4" are presented the reduced C.R.L. with their standards errors between various castes and tribes under study. It would appear from the table that except for Bhatia for which the measurements are based on a small group of thirty, the measurements on the remaining castes and tribes are based on a number exceeding fifty and in some cases as high as two hundred. All comparisons, therefore, of Bhatia with such castes and tribes as would indicate insignificant differences might prove to be significant if the sample size on which the Bhatia are based be increased. As would be seen in the following analysis reduced C.R.L. between Bhatia and Bhadela differ insignificantly from two, which may apparently

be taken as a close degree of resemblance of Bhatia and Bhadela and the evidence, as far it goes, indicates that the Bhatia and Bhadela have been random samples from the same population. A large sample of Bhatia would, however, be required to justify this hypothesis in an adequate manner.

82. We now proceed to obtain by this method clusters, and their interrelations as defined already in our study of individual characters of castes and tribes such that groups within a particular cluster are more closely associated with one another than groups belonging to two different clusters. As would be seen in the following pages, some of the clusters are not quite defined, owing to the existence of sub-clusters within some of the main clusters. In this investigation our main guide will be the evidence of close similarity only *i.e.*, of low reduced C.R.L. The evidence of more distant relationship will only be utilised to see how far these confirm the results obtained from study of low reduced coefficients. The nature of the group of series dealt with in this investigation suggests that the best limit to use in the present study is a reduced C.R.L. of seventeen. Due consideration has been taken of this number in obtaining the main cluster that is, the reduced C.R.L. between any two groups within any cluster does not exceed this number. In obtaining sub-cluster within the main cluster however, we have, even restricted ourselves to numbers much lower than this *i.e.*, 0-5. In speaking of insignificant difference of C.R.L. from a certain number we have utilised the well known statistical consideration that the difference from the number does not exceed three times the standard error of the coefficient.

83. The data presented in the table suggest the following main clusters of the whole material. The order in which the clusters are presented is also the order of their location on the ethnic scale.

(a) A group of closely associated tribes Bhil—Bhangi, Bhil and others, which form a compact cluster such that the reduced C.R.L. between any two of these does not differ significantly from unity, which thus seem to be random samples from the same homogenous population.

(b) A second cluster is formed by the four tribes, Koli, Artisans, miscellaneous group I and Machi-Kharwa. These define types resembling each other while they show no connections of the order considered with the above cluster. A further study of the tribes composing this cluster would show that Koli, Artisans and Miscellaneous group I seem to be more closely associated with one another (the reduced C.R.L. between any two being not significantly different from unity) than with the Machi Kharwa. The Machi-Kharwa, however, appear to belong to the main cluster on account of its greater resemblance with the Koli, Artisan and Miscellaneous group I than with the rest of the castes and tribes. It is thus more probable that the Koli, Artisan and Miscellaneous group I are random samples from the same population than that Koli, Artisan Miscellaneous group I and Machi Kharwas are.

(c) A third constellation having no connection with the first two is formed by the nine castes, Kunbi Pattidar, Sunni Bora, Luhana, Memon, Khoja, Rajput, Nagar Brahmin, Audich Brahmin and Oswal Jain, which though distinctly

different from the above clusters appears to be nearer on the ethnic scale to the clusters formed by the Koli, Artisan, Miscellaneous group I and Machi Kharwa than to Bhil, Bhangi, and Bhil and others. An intra-cluster study would, however, reveal the existence of a more closely associated set formed by the groups Kunbi Pattidar, Sunni Bora, Luhana, Nagar Brahmin, and Audich Brahmin such that the reduced C.R.L. between any two of these is less than that between any member of the set and any of the remaining four castes and tribes, *i.e.*, Oswal Jain, Memons, Khoja, and Rajput, and these may thus be taken to represent a sub-cluster of the main cluster formed by the nine castes and tribes mentioned above. In other words it is more probable that the castes and tribes Kunbi Pattidar, Sunni Bora, Luhana, Nagar Brahmin, and Audich Brahmin are random samples from same population than that Kunbi Pattidar Sunni Bora, Luhana, Nagar Brahmin, Audich Brahmin and Memons Khoja, Oswal Jain and Rajput are.

Of the remaining castes and tribes the reduced C. R. L. between the Khoja and Memon does not differ significantly from zero, so that there is no evidence that these two castes and tribes compared represent populations differing in type. It would also be seen that the Memon and Khoja which may be taken to form another sub-cluster seem to be associated with the sub-cluster formed by the Kunbi Pattidar, Sunni Bora, Luhana, Nagar Brahmin, Audich Brahmin and closely associated with the Luhana (C. R. L. between Luhana and Memon, Luhana and Khoja each not differing significantly from two). The Rajputs and Oswal Jain behave like two discrete sets without much association between themselves, also somewhat distanced on the ethnic scale from Memon and Khoja and yet nearer to the sub-clusters formed by Kunbi Pattidar, Sunni Bora, Luhana, Nagar Brahmin and Audich Brahmin. Close similarity might have been expected between these tribes but it is surprising to find that the evidence as far as it goes denotes that they might be random sample from a population of which Kunbi Pattidar, Sunni Bora, Luhana, Nagar Brahmin, Audich Brahmin, Memon, and Khoja are sub-populations.

The social group Miscellaneous group II, does not seem to belong to the cluster as the reduced C. R. L. in the case of Miscellaneous group II and Khoja does not differ significantly from 20—a number which is high, but at the same time the values of reduced C. R. L. are quite gratifying with the groups Kunbi Patidar, Sunni Bora, Luhana, Nagar Brahmin Audich Brahmin, which is a compact sub-cluster of the main cluster. Thus we may be justified in keeping the group miscellaneous group II along with our present cluster under study, but not inside it. The position occupied by this group is represented in the diagram. This location is also verified when considering the inter-relations of other clusters with miscellaneous group II.

(d) A fourth cluster is formed by the four tribes Mher, Rabari, Wagher and Miana. These define types which resemble one another closely but show no connections of the order considered with any one of the three clusters discussed above. An attempt to make inter cluster study would reveal that this constellation is nearer to the last mentioned cluster formed by nine castes and tribes than to the remaining two discussed above. It would be seen that of the four tribes forming this constellation, the Wagher, and the Mher seem to be more closely link up

with each other than with Rabari and Miana (C. R. L. between Waghers and Mher not significantly different from two). In other words it is more probable that the Waghars and Mher are random samples from the same population than that Waghars, Mher, Rabari and Miana are, which seem to suggest that Wagher and Mher form a sub-cluster of the main cluster formed by Mher, Miana, Waghar and Rabari. The Miana seem to be closely situated to Waghar and Mher, and somewhat distant from the Rabari which again seem to be more closely associated with the Waghar and Mher than with the Miana.

(e) Finally we have the constellation formed by the Parsi, Bhatia, Bhadela which seem to occupy an extreme position on the ethnic scale with Bhil, Bhangi and Bhil and others on the other extreme. An intra-cluster study would reveal and that the reduced C. R. L. between Bhatia, Bhadela and Bhatia and Parsi, are two and four respectively (in the sense of statistical significance) while that between Parsi and Bhadela, is as high as nine (C. R. L. does not differ significantly from nine) which seem to suggest that the Parsi and Bhadela are more closely associated with Bhatia, than between themselves. It is interesting to note that the Mianas, belonging to the cluster formed by the Wagher, Rabari, Mher and Miana seem to resemble closely the Bhatia and Bhadela, and yet distantly situated from the Parsi. It seems as if there are common ethnic strains between two clusters, the Mianas acting as an intermediary source of link.

84. To sum up, the 24 castes and groups can be broadly classified into five compact clusters with Bhil, Bhangi, Bhil and others, on one extreme of the ethnic scale with Parsi and Bhatia on the other. It is gratifying to note that the conclusions emanating from the study of reduced C. R. L. in the preceding pages support to a great extent the results obtained from the study of individual characters.

85. In fact the above analysis has been useful in supplying some additional information regarding the composition of the various clusters and their relative distances from each other. For instance it has thrown additional light on the patterning of the castes and tribes Kunbi Pattidar, Sunni Bora, Luhana, Memon, Khoja, Nagar Brahmin, Audich Brahmin, Oswal Jain, Rajput. The sub-clusters formed by the groups (Kunbi Pattidars, Sunni Bora, Luhana, Nagar Brahmin, Audich Brahmin) and (Memon, Khoja), which ultimately go to form the main cluster—a point on which information was rather incomplete in our study of individual characters.

86. If we put the clusters in tiers, the Bhil, Bhangi, Bhil and others will form the bed, the Parsi, Bhadola, and Bhatia, the topmost tier, and in between the tiers will be found the rest of the clusters in ascending order, they being (Koli, Artisan, Misc. group I, Machhi-Kharwa), (Kunbi Pattidar, Sunni Bora, Luhana, Memon, Khoja, Nagar Brahmin, Audich Brahmin, Oswal Jain, Rajput), (Mher Wagher, Miana, Rabari).

87. We should not think it necessary to attempt a comparative study of race origin in Gujarat as the data available elsewhere do not all have unimpeachable

claims for acceptance. Besides, the individual data of the 1931 Survey are not on record; when they are published, if at all, for already 16 years have passed since they were taken, we might be in a position to make a comparative study. Guha has given the means and standard deviations of a few social groups of Gujarat. He measured 105 Nagar Brahmin, 99 Bania-Jain, 93 Audich Brahmin, 40 Kathi and 31 Brahma-Kshatri in 1931, the means, standard deviations and co-efficient of variation of the data are given in Table 2, pp. 7-9 (Census of India, Vol. I, Pt. III, Ethnographical, Section A). These four social groups according to Guha are all the principal ethnic groups in Kathiawar and Gujarat. On the basis of the scrutiny of the anthropometric data on the four Maha-Gujarat castes, Guha finds intimate relationship between the Nagar Brahmin and the Bania-Jain. Brahmin and the Bania Jain, the Nagar Brahmin and the Kathi, and the Kathi and Brahma-Kshatri.

88. The Nagar Brahmin are found to be associated to Audich, and to the Brahma-Kshatri and the Kathi are found associated to the Bania-Jain. Audich are found associated to the Brahma-Kshatri, the Kunbi Pattidar whose means and standard deviations have not been given in the table for Gujarat castes and tribes though they are shown in the diagram of interrelations as having no association with any other castes in Gujarat. On the basis of the evidence provided for the Gujarat castes and tribes, Guha finds, the Kunbi Pattidar racially remote from the other castes, though they own association with the Audich. The length-breadth index worked out for the Nagar, Audich, Bania-Jain and Brahma-Kshatri, vary from 78.77 ± 0.24 of the Audich Brahmins, to 81.38 ± 0.26 of the Nagar, the Bania-Jain have an index of 80.58 ± 0.29 , the Kathi 80.71 ± 0.47 , and the Brahma-Kshatri 79.70 ± 0.44 . This brachycephalic tendency, he says, is also found among the Rajput who are associated with the Gujarat ethnic type.

89. Our measurements of the 24 tribes and castes, show the range of the cephalic index from 75.612 of the Bhils to 83.759 of the Bhadelas. The Parsi have a cephalic index of 82.472, the Bhatia 82.908, the Miana (Muslims) 82.445, the Khoja 79.953, the Memon 79.953, and Sunni Bora 79.912. The Luhana who have provided the recruiting base for the Muslims have a cephalic index of 79.454, corresponding to the indices among the Khoja, Memon and Sunni Bora; it is only the Miana who have a very high cephalic index, affiliating them to the Parsi and the Bhatia, for all these latter groups have a cephalic index above 80. If we follow the standard grouping into the ethnic types, dolichocephalic, mesocephalic and brachycephalic, Maha Gujarat has an interesting distribution. The Bhil and the miscellaneous tribes, show dolichocephaly, the Bhatia, Parsi, Bhadela, Rabari, and Miana are brachycephalic, and the rest are mesocephalic. Considering the large number of groups falling in the intermediate rungs, Maha-Gujarat is a Mesocephalic Province and not Brachycephalic. The Audich Brahmin have a cephalic index of 77.969, while the Nagar Brahmin have an index of 79.589. The Nagar are, therefore, more broadheaded than the Audich. The tribal or the artisan groups who are also recruited from the tribal substratum, but mixed with other castes, are dolichocephalous or have a tendency towards dolichocephaly. If Maha Gujarat is a mesocephalic region, as it appears to be, then this mesocephaly, may be a result of an admixture between

two racial strains, one a brachycephalous race, represented by the Parsi, the Nagar Brahmin, the Bhatia, the Bhadela, the Rabari and the Miana, the other a dolichocephalous strain represented by the tribal substratum, by the Bhil, and Bhangi, the Miscellaneous artisans (Koli, Dubla and Nayaka and others) and the Macchi and the Kharwa. In between lie the rest of the groups we have included in our Survey. The higher castes in Gujarat including the Parsi, and those who are known to be converted from the higher castes into Muslims, belong to an original brachycephalic race, the lower castes and tribes belong to a dolichocephalic one, but mixtures, large scale we think, have produced intermediate types who can be arranged in an order of racial distance from either of the two racial strains according to the degree of their blends.

90. It is difficult to find extreme platyrrhiny in Gujarat among any caste or tribe. The Bhil, the Koli, the miscellaneous artisans have got the highest nasal index, others from 68.487 of the Rajput to 75.292 of the Kunbi Pattidar. The Parsi have the finest nose, the nasal index being 67.673. The only group whose origin is non-tribal and who possess a high nasal index, *viz.*, 77.76 are the Oswal Jain, whom we measured mostly in Cutch. There is a general correspondence between head form and the shape of the nose, dolichocephaly is more or less correlated with flat nose, brachycephaly with fine nose, which shows that the dolichocephalic strain in the population of Maha Gujarat is also broad nosed, while the brachycephalous groups have a finer nose.

91. The Parsi, the Rajput, the Bhatia have the longest head, above 185 cms., the Bhil of Panchmahal as also of Rajpipla have the shortest length, below 180 cms., the rest range between. The Bhangi, the Koli and the Miscellaneous artisans, have comparatively longer head length. Similarly the tribal Bhil have the shortest breadth of the head, below 136 cms., while the Parsi, the Bhadela, and the Bhatia have the maximum head breadth, all being above 151 cms., the rest fall in between; the tribal groups and miscellaneous artisans resemble one another in both the characters. In minimum frontal diameter, the Parsi are at the top, the Bhil and the Bhangi lie at the bottom, the Muslim groups are intermediate but approach the Nagar Brahmin, and the Parsi more than they do the tribal or mixed tribal groups. The longest nose characterise the Parsi, the Rabari, the Rajput, the Waghar, and the two Brahmin groups have also long nose while the Bhil, the Bhangi and the Koli have a short nose. The nasal breadth does not show much variation and the distribution is a bit erratic though the absolute difference between one type and another is not much significant. The total facial length varies from 107.90 of the Koli, and 109.00 of the Bhangi and the Bhil to 114.70 of the Parsi, the higher castes approaching the Parsi, the lower castes and tribes the Bhil and the Bhangi. In stature the Bhil and the Bhangi and the Koli have a low value below 161.00 cms., the Mehr have the highest stature 169.51, then come the Rabari 168.22, the Waghar 167.95 and the Parsi 167.73. The sitting height varies from tribes to castes, the former have a low value for this character, the Parsi, the Waghar, and the Rajput have a higher value, the last having the maximum sitting height among all the castes and tribes of Gujarat.

92. From the study of the indefinite characters, we find support of the main conclusions we have reached on the basis of anthropometry. In any kind of dissection of the anthropometric data, we have seen, the tribal groups will occupy one extreme of the scale, the Parsi, the Bhatia and the Rabari and others, will occupy the other extreme. The Koli, the Bhil, the Machi and the Kharwa are darker in complexion than the Mixed miscellaneous and artisan groups, the Parsi, the Luhana and the Bhatia are fairer and even some of them possess sallow or rosy white complexion, the Rabari, the Mehr, the Rajput and Waghar are also fair and individuals among them are found to have a skin, tanned white—their habits of life do not show them in their natural colour. The lighter shades are characteristic of the higher castes, the Nagar Brahmin and Audich Brahmin, the Luhana, the Bhatia the Rajput and the Parsi, also the Rabari, the Mehr and the Waghar, the darker shades, from light brown to dark brown even occasional black, are found among the tribal groups, while among the Bhangi and the Bhil individuals often exhibit lighter skin, as compared to the general population among them. The Brahmin, the Luhana, Bhatia, Mehr, Rabari and Parsi own lighter eyes, and often have bluish grey or hazel eyes, while the hair on the scalp and body is usually plentiful and exhibiting wavy to curly textures. The women possess fine and graceful figures, with a tendency to flabbiness, while the men are hardy and strong.

93. Both from the definite and indefinite characters, the two racial strains in Gujarat, Kathiawar and Cutch are easily distinguished, but the intermediate rungs of the racial ladder follow imperceptably one after the other, producing a more or less homogeneous ethnic type. The Muslims of Gujarat unlike those of Bengal are more akin to the higher caste elements and the historical origin of the various Muslim groups of Maha Gujarat do not allow any scope for a different conclusion. The Khoja are similar to the Luhana, the Miana, and the Bhadela to the Bhatia and the Parsi, and the Rajput and Mehr have association with the Muslims. The Oswal of Cutch show occasional epicanthic folds in their eyes, and their origin would be an interesting study, the rest of the groups we have discussed in this report do not exhibit mongoloid infusion. The Muslims of Cutch, and of Kathiawar and the Sunni Bora, show occasional traces of woolly hair and thick and inverted lips, but the Negroid affinities, are due to absorption and not to any substratum of a Negrito race. Elsewhere I have mentioned about the infiltration of the Negroid population into Gujarat, and this did occur probably between the 8th to the 10th century. In Ratanpur, in the Rajpipla State, we have a colony of Negroid population. Their reputation, as sorcerers and healers and their shrine built upon the ruins of a desecrated Hindu temple attract people from different parts of Gujarat. The Negro element is also found in the Kathiawar States and in the coastal areas of Kathiawar and Cutch, there is quite a considerable number of families of Negroes who have married with the local population, mostly of the lower castes, assimilating non-Negro features. They have not any important contribution to make to the peopling of Maha-Gujarat and do not share in the blend represented by the members of castes, high and low, in this particular region.

94. From the serological study of the Gujarat castes and tribes we found a heterogeneity among the various social groups we sampled for blood group tests

This heterogeneity, we think, is due to the fact that there is a great deal of intermixture among the ethnic groups in Maha Gujarat. We found the Khoja and the Luhana to possess similar incidence of the blood groups, we found the Audich Brahmin, the Nagar Brahmin, the Bhatia, the Mehr, the Miana, and the Kunbi Pattidar, forming a constellation with respect of their p-values. We found also the Parsi having a similar serological status as those of the higher castes, for they approach the latter with respect of their of p-values. The Rabari and the Waghar are not permanently domiciled yet in Kathiawar or in Gujarat, and their isolation and that of the tribal groups explain their serological status *vis-a-vis* other ethnic groups. In a way, the serological evidence does not run counter to that provided by anthropometry and even if we have not established correlation between blood groups and anthropometric characters, we have not found our analysis devoid of significance. The scope for further inquiry is amply indicated by our Survey, and we feel that in respect of inter-group and intra-group relationship, the racial and serological investigations have provided the anticipated results. It would be fruitful to study intra-group variations among the castes, high and low, for anthropometry has proved to be an efficient tool in determining race affiliation and distance and with the aid of serology may be expected to unfold further the tangle of race origins. A historical study of race origins would be possible when we have complete data on inter-group and intra-group race relations.

TABLE 5.—SHOWING THE MEAN MEASUREMENTS WITH THEIR STANDARD ERRORS FOR THE PANCHMAHAL, RAJPIPLA AND KHANDESH BHILS FOR TEN CHARACTERS

Serial No.	Characters.	Panchmahals Bhil (187)	Rajpipla Bhil (215)	Khandesh Bhil (199)
1	Stature	162.67±0.50	159.58±0.37	160.05±0.52
2	Maximum Head Length ..	181.87±0.43	179.60±0.39	179.60±0.52
3	Maximum Head Breadth ..	137.48±0.34	136.70±0.28	135.80±0.41
4	Bizygomatic Breadth ..	131.32±0.36	128.40±0.27	128.40±0.38
5	Nasal Length	48.60±0.24	47.86±0.24	47.80±0.31
6	Nasal Breadth	37.49±0.18	36.60±0.18	37.15±0.24
7	Total Facial Length ..	112.22±0.49	109.40±0.41	109.87±0.58
8	Bigonial Breadth	100.49±0.37	97.30±0.39	99.20±0.47
9	Nasal Depth	24.11±0.14	23.65±0.14	23.13±0.13
10	Upper Facial Length ..	62.18±0.33	59.69±0.31	58.90±0.39

TABLE 6.—SHOWING THE NUMERIAL DIFFERENCE AMONGST THE THREE BHIL GROUPS FOR THE VARIOUS CHARACTERS

Serial No.		Panchmahal Bhils v.s. Rajpipla Bhils	Panchmahal Bhils v.s. Khandesh Bhils	Rajpipla Bhils v.s. Khandesh Bhils
1	Stature	3.09 $\frac{1}{2}$ $\frac{1}{2}$	2.62 $\frac{1}{2}$ $\frac{1}{2}$	0.47
2	Maximum Head Length ..	2.22 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2.22 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	0.00
3	Maximum Head Breadth ..	0.68	1.63 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	0.95 $\frac{1}{2}$
4	Bizygomatic Breadth ..	2.83 $\frac{1}{2}$ $\frac{1}{2}$	2.85 $\frac{1}{2}$ $\frac{1}{2}$	0.02
5	Nasal Length	0.74 $\frac{1}{2}$	0.80 $\frac{1}{2}$	0.06
6	Nasal Breadth	0.87 $\frac{1}{2}$ $\frac{1}{2}$	0.23	0.64
7	Total Facial Length ..	2.82 $\frac{1}{2}$ $\frac{1}{2}$	2.35 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	0.47
8	Bigonial Breadth	3.17 $\frac{1}{2}$ $\frac{1}{2}$	1.28 $\frac{1}{2}$	1.89 $\frac{1}{2}$ $\frac{1}{2}$
9	Nasal Depth	0.46 $\frac{1}{2}$	0.98 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	0.52 $\frac{1}{2}$
10	Upper Facial Length ..	2.48 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	3.27 $\frac{1}{2}$ $\frac{1}{2}$	0.79

TABLE 7.—SHOWING THE MEAN VALUES OF THE INDICES OF VARIOUS CULTURAL GROUPS OF MAHA GUJARAT

Serial No.	Groups.	Cephalic Index.	Nasal Index.	Facial Index.	Blgo-Blzy Index.
1	2	3	4	5	6
1	Bhatia	82.908	73.582	81.403	76.250
2	Koli	77.310	75.204	82.587	77.612
3	Artisans	77.728	75.659	82.518	77.609
4	Bhil	76.114	76.473	85.202	75.778
5	Miscellaneous Group I... ..	76.928	75.211	83.914	76.987
6	Miscellaneous Group II	79.145	73.384	83.555	76.821
7	Kunbi Pattidar	77.991	75.292	82.750	76.648
8	Sunni Bora	79.912	70.331	84.501	75.260
9	Miana	82.445	71.389	85.047	78.147
10	Mher	79.304	70.798	83.472	77.308
11	Rajput	78.122	68.487	84.215	75.908
12	Luhana	79.454	71.825	83.360	77.438
13	Memon	79.834	68.271	83.843	76.793
14	Khoja	79.953	70.321	84.430	76.406
15	Bhangi	76.615	74.787	84.289	77.047
16	Nagar Brahmin	79.589	71.779	82.678	76.461
17	Bhadela	83.759	73.539	83.366	76.889
18	Bhils and Others	75.612	77.719	85.568	77.258
19	Oswal jain	79.526	77.766	82.515	77.542
20	Machi Kharwa	77.795	75.557	83.157	76.998
21	Rabari	80.269	69.267	85.500	75.620
22	Waghar	79.235	71.238	85.470	77.877
23	Audich Brahmin	77.969	71.442	83.177	77.144
24	Parsi	82.472	67.673	83.049	75.266

PART III

A COMPARATIVE STUDY OF HEIGHT AND WEIGHT OF THE CASTES AND TRIBES OF GUJARAT

By

D. N. MAJUMDAR AND S. BAHADUR.

94. Recently a number of interesting comparisons of heights and weights have been made and new facts have been brought to light on the basis of such comparisons. In his paper on "Comparisons of Heights and Weights of German Civilians Recorded in 1946-47 of Royal Air Force and other British Series," Dr. G. M. Morant shows that changes were taking place in the distribution of measurements of British populations. Appreciable differences have been found between the mean height and recorded weight, and weights standardised for the mean height of German children of different towns. Similar comparisons have been made for adult population as well. The influence of occupation has also been determined as it is reflected in mean weights between heavy and light workers.

95. On the basis of the age and mean height given by the post-war Survey, it is found that the mean stature is greater than any of the pre-war mean of a regional section of male adult population of the British Zone of Germany and Dr. Morant thinks that pre-war standards for German men were probably underestimates of their mean heights. In other investigations it has been found that there is an increase in stature in all parts of the world during the last few decades, for example, Allain finds a continuous and a fairly rapid biological change to be in progress at present among young men entering Universities and probably others also. The proportion of undergraduates entering the University of Toronto, Canada, who were 6' tall or more of 17-20 years inclusive, increased from 6.8% to 17.5% and the proportion who were less than 5' 6" dropped from 18.8% to 9.7%. In other words, "In spite of depressing conditions over a long period, those who were entering University and Colleges show no sign in any way of being stunted, though the diet is obviously insufficient to maintain weight at levels regarded as normal a few years ago." The reason for the upward trend in height are yet to be discovered, but it must be pleasing to find that our race is not becoming diminutive or there is nothing inherently wrong with our social order. Similar investigations in India might show the trend of biological change among the different sections of the population. In India, investigation can be carried on among the various endogamous groups at different levels of cultural development with different dietetic standards so that we may be able to tell whether improved dietary, knowledge of improved hygiene, or the germ cells determine such variations in stature and weight.

96. The present material cannot give us any of the above informations except the changes that occur in the distribution of measurements for different endogamous groups for the adult population varying from 18 to 48 years of age.

STATISTICAL STUDY OF AGE, WEIGHT, STATURE OF 15 SOCIAL GROUPS OF MAHA GUJARAT

97. On classifying the raw data according to the requirements of the present analysis, we find that the maximum number of individuals falls within the age group 20-32 years except for the groups Oswal Jain, Bhadela and Kunbi Pattidar. In the case of the latter the concentration of the individuals is between the ages 30-40 years (Table 2). As there are very few individuals below 18 years and above 48 years except among Machhi Kharwa and Rajput in both of which the number of individuals above 48 years are fairly numerous, but they have been omitted for our purpose as a separate consideration was not possible. The importance of the age group (18 years to 48 years) must be conceded as physical maturity starts generally from 18 years of age onwards and in old ages there is a decline in physical competence and standards. This distribution of individuals on age basis appears satisfactory in a sense, particularly in accordance with the sampling technique which suggests that representative type of individuals should be considered at random to give a complete picture of the social groups, they come from. As a matter of fact the precision of the average values is considerably affected by the number of individuals considered in a particular social group. In the present context the total number of individuals in a social group is generally 100 except for Bhatias (29), Bhangi (40) and Bhadelas (51). On further classifying these groups into sub-groups on age basis the number of individuals in such case is markedly reduced, and the present material, therefore, should be examined under these limitations. We propose, however, to exclude those mean values from our statistical study, which are based on very small samples, as it is likely that these may influence the general trends of our conclusions.

98. From the preliminary examination of the material, it appears that the social groups differ between themselves with respect to magnitude and arrangement, in weight and stature and also the distribution of these two characters is different as regards their ages. It is found in some cases that individuals belong to a particular age were absent from our data. In the case of Wagher Muslims, for example, there were no individuals beyond the age of 38 years. Similarly there is a gap between the ages 39-45 years in case of Bhadelas as a result of which we could not study the groups at these age periods.

99. It is found that the variation in case of stature is smaller than that of weight, which is natural, as the stature is constitutional to some extent and depends upon the racial status of the individual or of the group as a whole, while the weight depends primarily upon health and nutritive conditions. It will also be seen from the Tables that there are some sudden increase or decrease in both the characters which is partly due to the small number of individuals on which mean values are based, and partly due to abnormal values of the characters themselves.

100. As the present values of the means of the two characters have been considered for all the social groups examined here, the differences in the mean values are studied only with respect to age; the possibility of the mean values being quite different in two different social groups for the same age cannot, however, be ruled

out. To eliminate this we have considered each social group separately, but then we have grouped the individuals in intervals of 5 years. This was done simply because in India the consideration of age, its recording and remembering, is not at all important for an individual. One will not hesitate in telling one's age as 30 years even when he may be 40 or more. There are no records anywhere from which to check and verify, as vital statistics is defective in India and registration of births and deaths does not give any accurate idea of the trends of Indian demography. Educational institutions are also not free from this defect. Guardians feel pride in entering the wrong age of their ward in school register showing probably that the latter started education at an early age or could take an examination too early for his age; the above considerations make it necessary that we should take age groups rather than individual ages. The grouping of ages also finds support in the fact that the variation of the characters within particular age groups is considerably smaller, making them more or less homogeneous though there were exceptions.

Keeping the above points in view the mean values of stature and weight have been arranged group-wise considering the social groups separately.

101. *Inter-group Study* :—In the age group 18.5-23.5 years, Bhatia occupy the highest position with mean weight 114.6 lbs. and mean stature 164.4 cm. then in order comes Oswal Jain having 108.6 lbs. and 164.6 cm. as their mean weight and stature respectively. Next in order come Nagar Brahmin 105.1 lbs., 162.4 cm. Rajput 103.7 lbs., 163.4 cm., Bhadela 101.6 lbs., 163.0 cm., Luhana 100.7 lbs. 164.4 cm., Audich Brahmin, Kunbi Pattidar come next with Artisans, Machhi-Kharwa, Misc. Gr. I and Bhangi as the last having the minimum values for mean weight and stature in this age group. Of course the Waghar both Hindu and Muslim do not resemble any and they occupy a distinct position, in all the age groups.

102. Next to the above age group we have the classification of social groups for ages 23.5-28.5 years. Here again we see that Bhadela 118.4 lbs., 165.7 cms., Bhatia 117.3 lbs., 166.3 cm., Luhana 117.0 lbs., 166.1 cm., Audich Brahmin 112.3 lbs., 165.2 cm., Oswal Jain 111.7 lbs., 163.0 cm., occupy their respective positions as, placed here. Nagar Brahmin, Rajput, Kunbi Pattidar come next with Artisans Machhi Kharwa, Misc. tribal I and Bhangi having the lowest values of the two characters in this case also.

103. Further, in case of the age group 28.5-33.5 years the Bhatias stand at the top but as this value is based on 3 individuals, we will not hazard an opinion. The arrangements of the groups in this case is quite similar to the two cases cited above. They being arranged thus : Bhadela 126.8 lbs., 166.1 cm., Luhana 122.5 lbs., 165.4 cm., Oswal Jain 114.9 lbs., 165.1 cm., Nagar Brahmin 113.5 lbs., 164.8 cm., Rajput 112.1 lbs., 165.7 cm. Audich Brahmin 110.9 lbs., 166.7 cm. The lowest position occupied by the groups, Machhi-Kharwa, Artisans, Koli and Bhangi as in the previous cases is quite gratifying.

104. Considering the age group 33.5-38.5 years the relative arrangement of the groups remains more or less unchanged with Bhadela 139.6 lbs. 165.1 cm. Bhatia

132.8 lbs. 163.5 cm. Kunbi Pattidar 118.4 lbs., 164.2 cm., Nagar Brahmin 115.6 lbs., 163.5 cm., Luhana 115.1 lbs., 163.5 cm., Oswal Jain 112.6 lbs., 164.2 cm., Rajput 105.3 lbs., 160.2 arranged in order. Towards the end come again the same groups, Artisans, Machhi-Kharwa, Koli, Bhangi and Miscellaneous Group I.

105. We see from Table I, that in the last two age groups there is a gradual decrease in the number of individuals falling within it. This will considerably affect the conclusion but to remove this we have not considered such cases whenever they occurred.

106. In case of the last but one age group ranging from 38.5-43.5 years, the relative position of the groups remain unchanged except for Kunbi Pattidar who occupy here the top-most position with 143.1 lbs., weight and a stature of 165.4 cms. The rest are arranged as follows :—Nagar Brahmin 129.4 lbs., 164.3 cms., Luhana 122.8 lbs., 163.2 cm., Audich Brahmin 121.4 lbs. 163.4 cms., Oswal Jain 116.3 lbs., 163.3 cm., Rajput 105.0 lbs., 165.6 cm. with Artisans, Machhi Kharwa, Koli, Misc. Gr. I, the Bhangi occupying the lowest position.

107. Coming to the last group with ages ranging from 43.5-48.5 years, we find that the arrangement is with Nagar Brahmin 125.7 lbs. 162.0 cm., at the top of the scale, followed by Oswal Jain 120.8 lbs., 163.9 cms., Kunbi Pattidar 120.4 lbs., 164.7 cms., Audich Brahmin, Luhana and Rajput coming next to the above with Artisans, Koli, Machhi Kharwa, Miscellaneous Group I, and Bhangi occupying the other extremity.

Intra-Group Study :—From Intra-group study a very interesting feature is revealed by the present material. As we have considered two different individuals at different ages and not the same individual at different ages. of course, of the same ethnic group, we may not be in a position to say anything definite about the increasing or decreasing tendency in the mean values of the characters as we proceed from younger to older generation. As will be evident from the Table 1, in case of stature the mean values record a decline.

108. The mean values of stature in case of the groups Bhadela, Oswal Jain, Audich Brahmin, generally centre round 165 cms. with a very slight increase or decrease from this value, which the mean values of stature in case of the groups Kunbi Pattidar, Rajput and Nagar Brahmin fall generally below this value; the range of variation in both the above sets being very small. In case of the groups, Artisans, Koli, Machhi-Kharwa, Miscellaneous Group I and Bhangi described as the lowest groups on the basis of the physical features, the mean values are generally centred round 160 cms. and the order of variation from one age group to the other is slightly more than in the previous groups. Studying the order of variation in these cases in various age groups, we may conclude that among the higher castes there is more homogeneity than is obtained among the lower castes or groups. How far this is due to intermixture is worth investigation. Considering the distribution of weight at various age groups for each social group we see that Luhana, Nagar Brahmin and Bhadela exceed 120 lbs. in weight and the range

of variation in these groups is also significantly high. The mean values of weight in case of the lowest groups, *i.e.*, Koli, Artisans, Misc. Gr. I, Machhi-Kharwa, and Bhangi do not exceed 110 lbs., in any of the age groups and the range of variation is insignificant.

109. As we know that social and economic factors do influence the body-build on the basis of *a priori* knowledge we may arrange the groups with respect to their economic and social status. The arrangement will be of the following order. Nagar Brahmin, Audich Brahmin, Luhana, Rajput, Bhatia, Oswal, Jain, Kunbi Pattidar, Misc. Gr. I, Koli, Machhi Kharwa and Bhangi. This arrangement finds support in the light of the present analysis, *i.e.*, higher social groups being physically well placed and the lower classes physically handicapped. It may be presumed that among the lower class strenuous physical labour probably due to the nature of their work, and malnutrition due to lack of means, adversely affect the body-build.

110. To sum up, we find on the basis of the mean values of weight and stature in various age groups, that Bhadela, Bhatia, Nagar Brahmin, Oswal Jain, Rajput, Luhana, Audich Brahmin and Kunbi Pattidar stand at one end of the racial ladder with Artisans, Machhi-Kharwa, Koli, Bhangi occupying the other extremity. The case of the Wagher (Hindus and Muslims) is different and distinct with respect to these two characters in all the age groups, and so their actual position is difficult to ascertain *vis a vis* other social groups. It is interesting to find, however, that the relative positions of the groups considered here, follow conclusions we have recorded regarding the various constellations with respect to their mean values, in the previous part of the report. We are continuing the correlation analysis, fitting of straight lines, finding out the regression of weight on height which will enable us to standardise weights making allowance for difference in stature at various ages. Then the differences if any will be directly comparable. Here we have included only 15 groups out of the total of 24. In future, along with this analysis we are considering all the 24 groups as was done in the analysis of the anthropometric data.

CALORIE REQUIREMENT

111. The efficiency of a nation depends largely on people's food. The diet taken all over the world contains (1) Carbo-hydrates, (2) Fats, (3) Proteins, (4) Vitamins and small amounts of salts and water. The water is the principal constituent of the human body and it varies from 65 to 58 per cent. according to age, decreasing with old age. The intake of food is meant for growth and repair of the body and to provide the necessary heat units or calories that are required to keep the body warm and enable it to perform its function including locomotion and strenuous work in the mills and factories. The right quantity of calories and a proper balance between the various ingredients of food, such as protein, carbohydrates, fat, mineral salts and vitamins which are matters of concern to the nutrition worker, is also of paramount interest to the economist as on the basis of this, he has to estimate the food requirements of the people.

112. There is not much agreement about the minimum or the maximum amount of calories needed in India or in any other part of the world. There is certainly some

difference in the necessary intake of calories in different countries, as the climatic conditions differ and the needs of a cold country are certainly greater than those one feels in a hot country. Sir Robert MacCarrison (Food pp. 110-111) states that 2,500 to 3,500 calories according to the part of India where he lives, and to the work he has to do, are needed for an Indian man, and 80% of this is needed by a woman. Dr. Aykroid's enquiry shows that 2,600 calories per day for males and 2,080 calories per day for females is necessary. The League of Nations Committee on Nutrition makes an allowance of 2,400 calories per day as adequate to meet the requirements of a normal healthy adult male or female living in ordinary every day life in a temperate climate with addition of further supplementary quota of calories according to the nature of work.

113. Dr. Aykroid allows 10 per cent reduction of this League of Nations model for India; for he thinks, India is a warm country in which the diet is largely vegetarian. Dr. N. R. Dhar thinks that for a healthy person 2,500 to 2,800 calories in the form of food per day is necessary in our country. Sir Alfred Chatterton quoting medical opinion held that 15 calories per pound of body weight was needed to keep a man in normal health and if the average weight of the Indian is 120 lbs., the total calories required will be $120 \times 15 = 1,800$ calories. Prof. Adarkar estimates the calorie requirement at 1,800 calories but considering the warmth of the country and the hot sun, he thinks 1,400 to 1,600 calories per man per day is enough. The various estimates are largely due to the variable factors on which the calorie requirements have been assessed, viz., weight, stature, climate and so on, and if we agree about the factors determining the calorie needs, we should not be surprised at the various estimates given by competent scientists.

114. Calorie required is not a function of weight but of the surface area of the body; the ease with which tea in a saucer loses its heat compared to the time required for cooling tea in the tea cup, is a proof that more the surface area of the body the greater is the ease with which body heat can be lost, viz., the surplus heat which is not converted into energy for work. If that is so, the surface area is an important consideration in the estimate of calorie needs. Environment is also an important factor, and therefore, the calorie needs should be a function of both surface area of the body and the climate.

115. A very useful formula for the determination of the surface area, based on height \times weight \times a constant has been worked out by Dr. D. Du Bois. As a result of this work, it is common practice now to take as the fundamental unit the output per sq. meter of surface area.

The actual formula is given by the expression :

$$S = W^{0.425} \times H^{0.725} \times C$$

$$\log S = 0.425 \log W + 0.725 \log H + \log C.$$

where S = Surface Area.

W = Weight in Kgms.

H = Height in Cms.

C = Constant = 0.007184

Booth and Sandiford of the Mayo clinic prepared a chart for computing the surface area of the body from height and weight. The values that are given below have been found out by placing the corresponding readings of weight and height on the chart and reading out the values of surface area as given in the footnote.

116. We shall give an estimate of the surface area so that the basal metabolism or the minimum calorie requirements can be estimated from it. The basal metabolic rate is given by the expression $S \times 40$ cal per hour where S is surface area in sq. meter.

117. As we are considering adults only *i.e.*, individuals of 18 years upto 48 years of age, our conclusions will be limited to this range only. There is an increase in Basal Metabolism Rate as we advance in age in all the social groups but beyond the age of 43 years as is given in the Table 4, there is a decreasing tendency in the B.M.R. which is true as old people generally retire from active life. The rate of increase in the B.M.R. is more rapid in the first three age groups *i.e.*, from 18 years to 33 years of age which is considered to be the most vital part of the whole life in all the fields. In the later and less active part of life, the rate remains more or less uniform and the intake of food is mostly utilised in maintaining the acquired state. It is also true that there is a slight decrease in the B.M.R. after the completion of puberty, which rises and is maintained afterwards. The racial classification on the basis of B.M.R. is attempted here, though there is not much startling difference in the values of S.A. for different social groups at various age groups.

118. In the first age group the arrangement is as follows :—Bhatia, Oswal Jain, Nagar Brahmin, Rajput, Luhana, Bhadela, arranged in a descending order of S.A. at one end, and Kunbi Pattidar, Audich Brahmin, Artisan, Koli, Miscellaneous Group I, Machhi Kharwa, Bhangi, at the other end. In the second age group—the relative position of the various social groups is with the Bhatia, Bhadela, Luhana, coming at the top, Rajput, Oswal Jain, Nagar Brahmin, Audich Brahmin, Kunbi Pattidar as the intermediate groups and the Artisans, Koli, Miscellaneous Group I, Machhi Kharwa and Bhangi occupying the lowest position.

119. In the third age group also the arrangement remains practically the same with Bhatia, Bhadela, Luhana, coming at the top, Rajput, Oswal Jain, Nagar Brahmin, Audich Brahmin, Kunbi Pattidar, occupying the intermediate position with Artisans, Koli, Miscellaneous Group I, Machhi Kharwa, and Bhangi at the bottom.

120. In the fourth age group the arrangement is that the Bhadela, Bhatia come first, next to the above groups are Kunbi Pattidar, Luhana, Nagar Brahmin, Oswal Jain, Audich Brahmin, Rajput being last of these groups. The position of the Artisans, Koli, Miscellaneous Group I, Machhi Kharwa and Bhangi remains unchanged *i.e.*, here also they come in the end.

121. In the fifth age group, other groups behave in the same way except that Kunbi Pattidar occupy the highest position here. As there was no individual in this age group, of Bhadela, we could not consider them. Here also the Artisans, Koli, Miscellaneous Group I, Machhi-Kharwa, and Bhangi occupy the last position.

122. In the last age group, the Bhatia, and the Bhadela remain where they were in the previous group, but the Bhangi have joined the Bhadela and the Bhatia. Bhangi have come with the Nagar Brahmin, Oswal Jain, Kunbi Pattidar, and the Luhana, have been displaced a little thus coming with Audich Brahmin and Rajput in the group arranged next to the above. Of course, the Artisans, Koli, Miscellaneous Group I, Machhi-Kharwa remaining at the bottom.

123. On the basis of the classification of the social groups at various ages with respect to B.M.R. we find the Parsi, the Bhatia, the Bhadela and the Luhana come at the top, with Audich Brahmin, Nagar Brahmin, Oswal Jain, Rajput, Kunbi Pattidar occupying an intermediate status while the Koli, Artisans, Miscellaneous, Machhi Kharwa, and Bhangi are at the bottom.

124. The high basal metabolic rate of the Parsi may have been influenced by the fact that the Parsi measured belonged to the middle class, with a preponderance of the upper middle. The racial status of the Parsi, also should have some influence on the estimate, as the Parsi are a taller and stronger group even today, though we cannot say the same thing with regard to the lower income groups, and the mixed elements.

TABLE 1, SHOWING THE MEAN VALUES OF STATURE AND WEIGHT OF 15 SOCIAL GROUPS OF MAHA GUJARAT
AT VARIOUS AGE GROUPS

AGE GROUPS		18.5—23.5		23.5—28.5		28.5—33.5		33.5—38.5		38.5—43.5		43.5—48.5			
		Weight	Stature	Weight	Stature	Weight	Stature	Weight	Stature	Weight	Stature	Weight	Stature		
SOCIAL GROUPS															
1	Nagar Brahmin	..	..	105.1	162.4	107.9	156.3	113.5	164.8	115.6	163.5	129.4	164.3	125.7	162.0
2	Audich Brahmin	..	..	98.1	162.2	112.3	165.2	110.9	166.7	107.1	164.8	121.4	163.4	106.8	161.1
3	Luhana	..	..	100.7	164.4	117.1	166.1	122.5	165.4	115.1	163.5	122.8	163.2	108.0	161.5
4	Rajput	..	..	103.7	163.4	108.0	164.7	112.1	165.7	105.3	160.2	105.0	165.6	98.5	163.3
5	Bhatia	..	..	114.6	164.4	117.3	166.3	145.3	166.0	132.8	163.5	121.2	169.6	151.2	164.4
6	Oswal Jain	..	..	108.6	164.6	111.7	163.0	114.9	165.1	112.6	164.2	116.3	163.3	120.8	163.9
7	Kunbi Pattidar	..	..	96.6	162.0	107.9	164.5	109.5	164.9	118.4	164.2	143.1	165.4	120.4	164.7
8	Artisans	..	..	97.4	161.6	102.8	160.6	99.8	162.0	101.8	160.7	104.8	163.4	96.5	155.3
9	Wagher Hindu	..	..	144.0	170.2	123.0	169.5	118.6	167.7	122.7	168.7	125.3	171.7	119.2	167.7
10	Wagher Muslim	..	..	108.5	160.3	117.2	167.4	119.2	168.9	109.0	162.8	...	...	...	...
11	Bhadela	..	..	101.6	163.0	118.4	165.7	126.8	166.1	139.6	165.1	...	...	140.0	166.8
12	Misc. Group I.	..	..	90.7	158.4	96.9	160.5	100.4	162.3	96.4	159.8	100.6	161.6	96.8	161.1
13	Koli ..	..	..	93.4	158.8	99.5	162.5	101.5	162.9	100.6	159.6	98.0	160.3	96.8	160.3
14	Machhi Kharva	..	..	97.0	158.9	99.1	161.0	108.4	160.4	100.4	149.9	104.3	159.8	107.2	161.9
15	Bhangi	..	..	83.0	157.5	95.8	161.4	87.6	157.0	98.6	161.5	98.0	155.2	110.3	171.0

TABLE 2, SHOWING THE NUMBER OF INDIVIDUALS OF CASTES AND TRIBES,
FALLING WITHIN VARIOUS AGE GROUPS

AGE GROUPS .. YEARS	18.5	23.5	28.5	33.5	38.5	43.5	Total	Below 18 yrs.	Above 48 yrs
	23.5	28.5	33.5	38.5	43.5	48.5			
SOCIAL GROUPS									
* Nagar Brahmin	21	22	22	10	8	11	94	..	2
Audich Brahmin	28	20	21	14	7	7	97	..	1
Luhana	27	35	33	18	8	5	126	..	6
Rajput	10	19	24	12	16	10	91	..	10
Bhatia	5	7	3	6	4	4	29	..	..
Oswal Jain	3	14	27	42	6	7	99	..	1
Kunbi Patidar	16	13	29	20	8	13	99	..	1
Artisan	34	20	25	17	17	7	120	..	6
Wagher	8	37	45	18	3	4	115	..	2
Bhadela	3	11	19	15	..	3	51	..	..
† Miscellaneous Group I	39	19	32	21	15	6	132	..	3
Koli	42	21	32	12	4	6	117	..	1
Machhi-Kharwa	10	18	42	16	14	14	114	1	18
Bhangi	11	8	11	5	2	3	40	1	2

* In 6 cases age was not given.

† In 5 cases age was not given.

TABLE 3, SHOWING THE SURFACE AREA IN SQ. METRES

AGE GROUPS .. YEARS	18.5—23.5	23.5—28.5	28.5—33.5	33.5—38.5	38.5—43.5	43.5—48.5
SOCIAL GROUPS						
Nagar Brahmin ..	1.47	1.45	1.53	1.54	1.61	1.58
Audich Brahmin ..	1.41	1.52	1.53	1.50	1.56	1.47
Luhana	1.45	1.57	1.59	1.54	1.57	1.48
Rajput	1.46	1.50	1.54	1.45	1.49	1.43
Bhatia	1.54	1.57	1.71	1.62	1.61	1.71
Oswal Jain	1.50	1.51	1.54	1.52	1.54	1.56
Kunbi Patidar ..	1.41	1.49	1.51	1.56	1.70	1.57
Artisans	1.41	1.44	1.44	1.43	1.46	1.36
Bhadela	1.44	1.57	1.61	1.66	..	1.68
Misc. Group I. ..	1.37	1.40	1.43	1.39	1.42	1.40
Koli	1.36	1.43	1.45	1.42	1.41	1.41
Machhi-Kharwa ..	1.40	1.42	1.47	1.35	1.45	1.40
Bhangi	1.30	1.33	1.32	1.41	1.36	1.56

TABLE 4, SHOWING THE B. M. RATE IN CAL/SQ. METRE OF S. AREA
FOR VARIOUS COMMUNITIES OF MAHA GUJARAT AT VARIOUS
AGE GROUPS

AGE GROUPS .. YEARS	18.5—23.5	23.5—28.5	28.5—33.5	33.5—38.5	38.5—43.5	43.5—48.5
SOCIAL GROUPS.						
Nagar Brahmin ..	58.8	58.0	61.2	61.6	64.4	63.2
Audich Brahmin ..	56.4	60.8	61.2	60.0	62.4	58.8
Luhana ..	58.0	62.8	63.6	61.6	62.8	59.2
Rajput ..	58.4	60.0	61.6	58.0	59.6	57.2
Bhatia ..	61.6	62.8	68.1	64.8	64.4	68.4
Oswal Jain ..	60.0	60.4	61.6	60.8	61.6	62.4
Kunbi Pattidar ..	56.4	59.6	60.4	62.4	68.0	62.8
Artisans ..	56.4	57.6	57.6	57.2	58.4	54.4
Bhadela ..	57.6	62.8	64.4	66.4	....	67.2
Misc. Group I. ..	54.8	56.0	57.2	55.6	56.8	56.0
Koli ..	54.4	57.2	58.0	56.8	56.4	56.4
Machhi-Kharwa ..	56.0	56.8	58.8	54.0	58.0	56.0
Bhangi ..	52.0	53.2	52.8	56.4	54.4	62.4

TABLE 5, SHOWING THE BASAL METABOLIC RATE IN CAL/SQ. METRE OF SURFACE
AREA AMONGST ALL THE 23 GROUPS OF MAHA GUJARAT OF ALL AGES

						Basal Cal Re- quirements.
1	Bhatia ..	..	..	..	64.4 Cal/Sq. M. of S. Area	1545.6
2	Koli ..	..	..	..	56.8	1363.2
3	Artisans ..	..	..	..	57.2	1372.8
4	Bhil ..	..	..	..	56.0	1344.0
5	Misc. Group I. ..	..	..	..	56.0	1344.0
6	Misc. Group II ..	..	..	..	....	....
7	Kunbi Pattidar ..	..	..	..	61.2	1468.8
8	Sunni Bora ..	..	..	..	58.8	1411.2
9	Miana ..	..	..	..	64.0	1536.0
10	Mher ..	..	..	..	65.2	1564.8
11	Rajput ..	..	..	..	60.0	1440.0
12	Luhana ..	..	..	..	61.6	1478.4
13	Memon ..	..	..	..	61.6	1478.4
14	Khoja ..	..	..	..	62.4	1497.6
15	Bhangi ..	..	..	..	54.4	1305.6
16	Nagar Brahmin ..	..	..	..	58.4	1401.6
17	Bhadela ..	..	..	..	64.8	1555.2
18	Oswal Jain ..	..	..	..	61.6	1478.4
19	Machhi Kharwa ..	..	..	..	58.0	1392.0
20	Rabari ..	..	..	..	63.2	1516.8
21	Wagher ..	..	..	..	63.6	1526.4
22	Audich Brahmin ..	..	..	..	60.4	1449.6
23	Parsi *	..	..	..	66.4	1593.6

* We shall discuss the Parsi along with other groups with regard to their stature and weight later on.

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(1)



BRAHMIN (FRONT)

(1a)



BRAHMIN (PROFILE)

(2a)

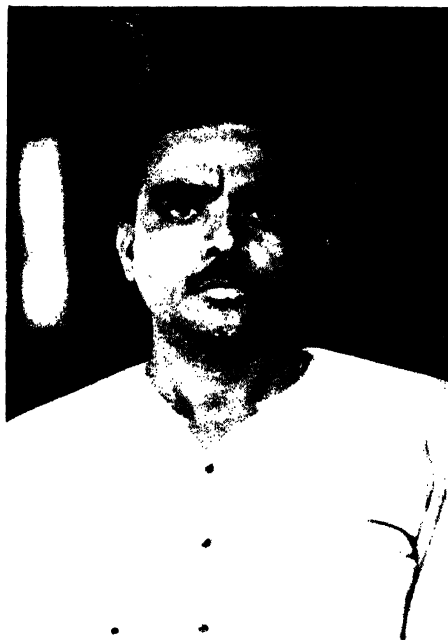


BHADELA (FRONT)



BHADELA (PROFILE)

(3)



I HATIA (FRONT)

(4)

(3a)



BHATIA (PROFILE)

(4a)



KOLI (FRONT)



KOLI (PROFILE)

(5)



KUNBI PATTIDAR (FRONT)



KUNBI PATTIDAR (PROFILE)

(6a)



KUNBHAR (FRONT)
(Misc. Artisan)



KUNBHAR (PROFILE)

(7)



LUHANA (FRONT)

(8)



MHER (FRONT)

(7a)



LUHANA (PROFILE)

(8a)



MHER (PROFILE)

(9)



MIANA (FRONT)



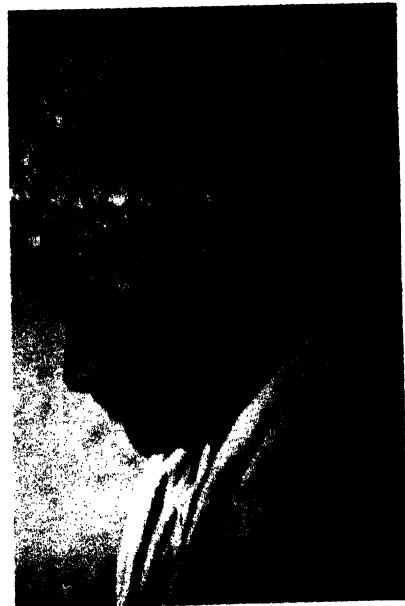
MIANA (PROFILE)

(10)



OSWAL JAIN (FRONT)

(10a)



OSWAL JAIN (PROFILE)

(11)



RABARI (FRONT)

(11a)



RABARI (PROFILE)

(12a)



RAJPUT (FRONT)



RAJPUT (PROFILE)

(13)



WAGHER (FRONT)

(13a)



WAGHER (PROFILE)

(14)



PARSI (FRONT)

(14a)



PARSI (PROFILE)

(15)



A KHOJA (FRONT)

(16)



AN AUDICH BRAHMIN (PROFILE)



A BHIL (FRONT)

(18)



A BHILL (PROFILE)



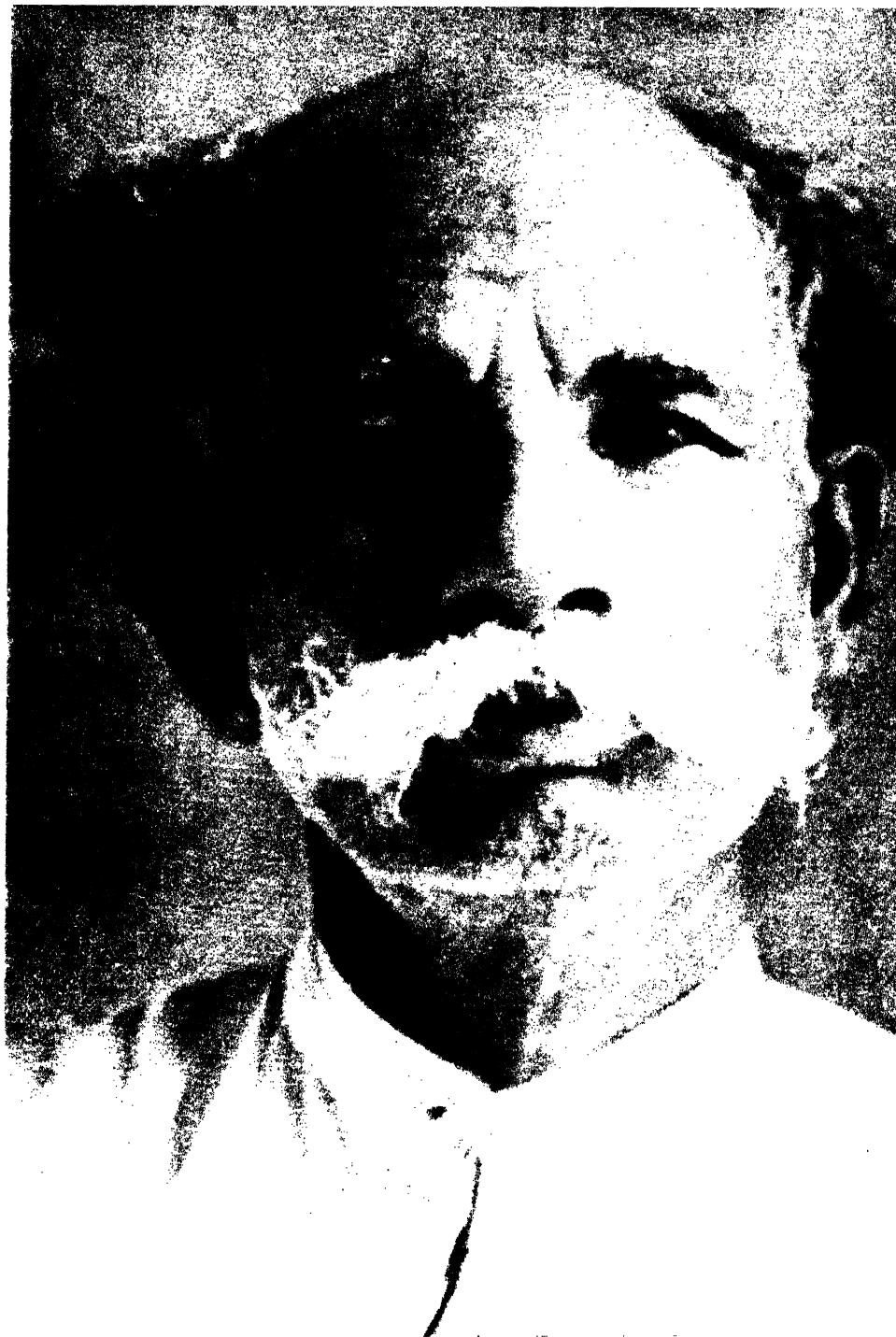
BHIL (FRONT



BHIL (PROFILE)



A KHOJA (PROFILE



A Kharwa (FRONT)



A KHARWA (PROFILE)



MEGHWAR (FRONT)

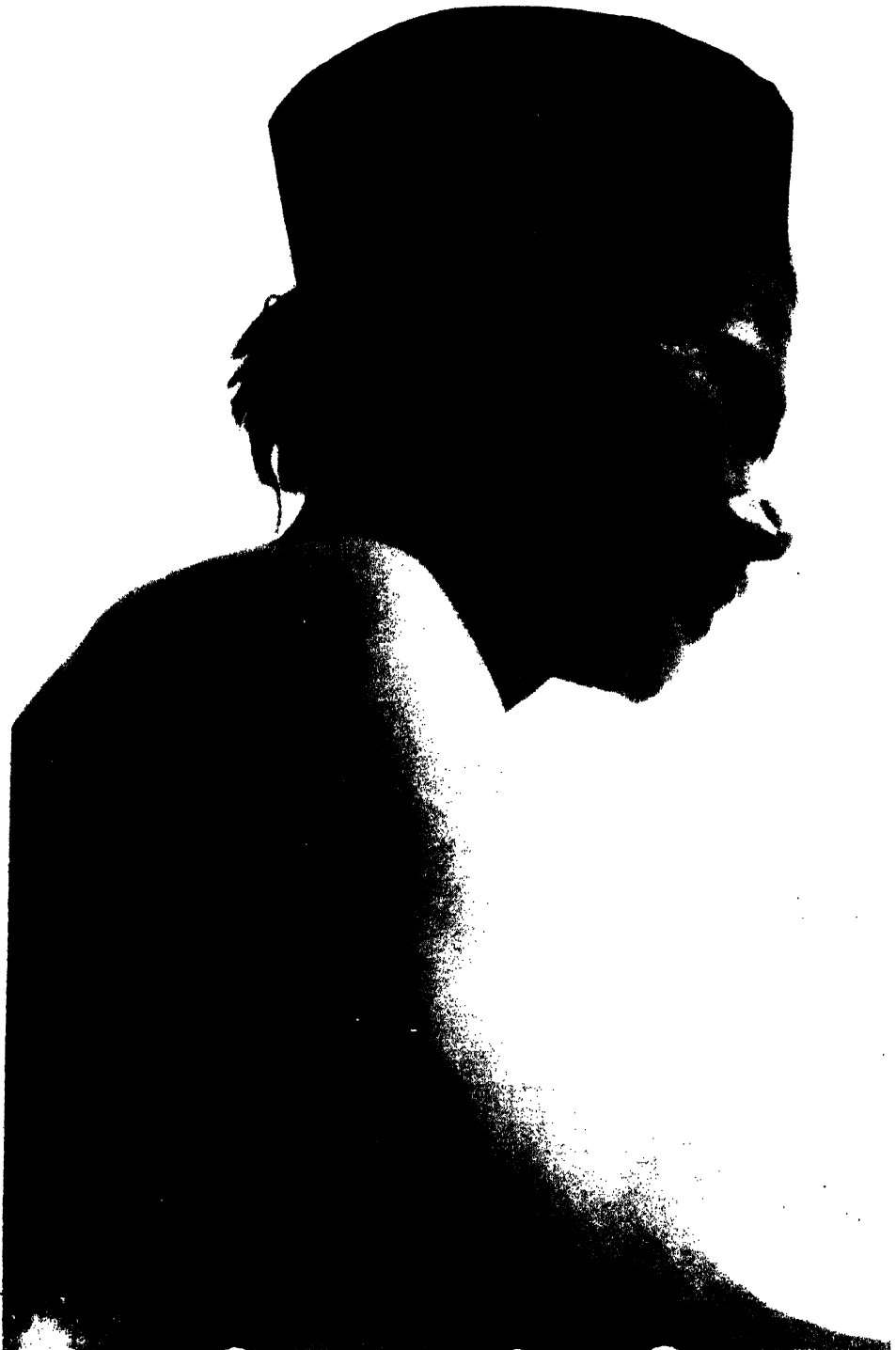


MEGHWAR (PROFILE)

(24)

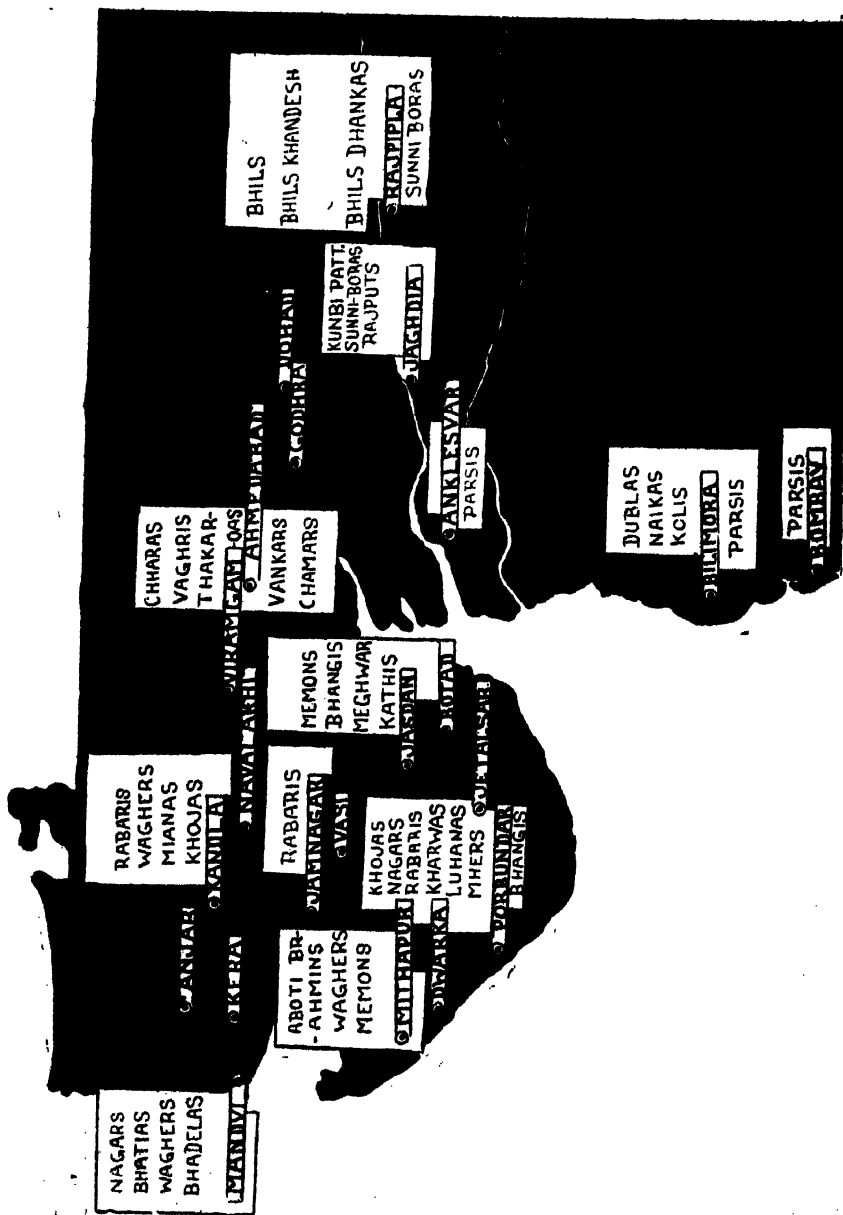


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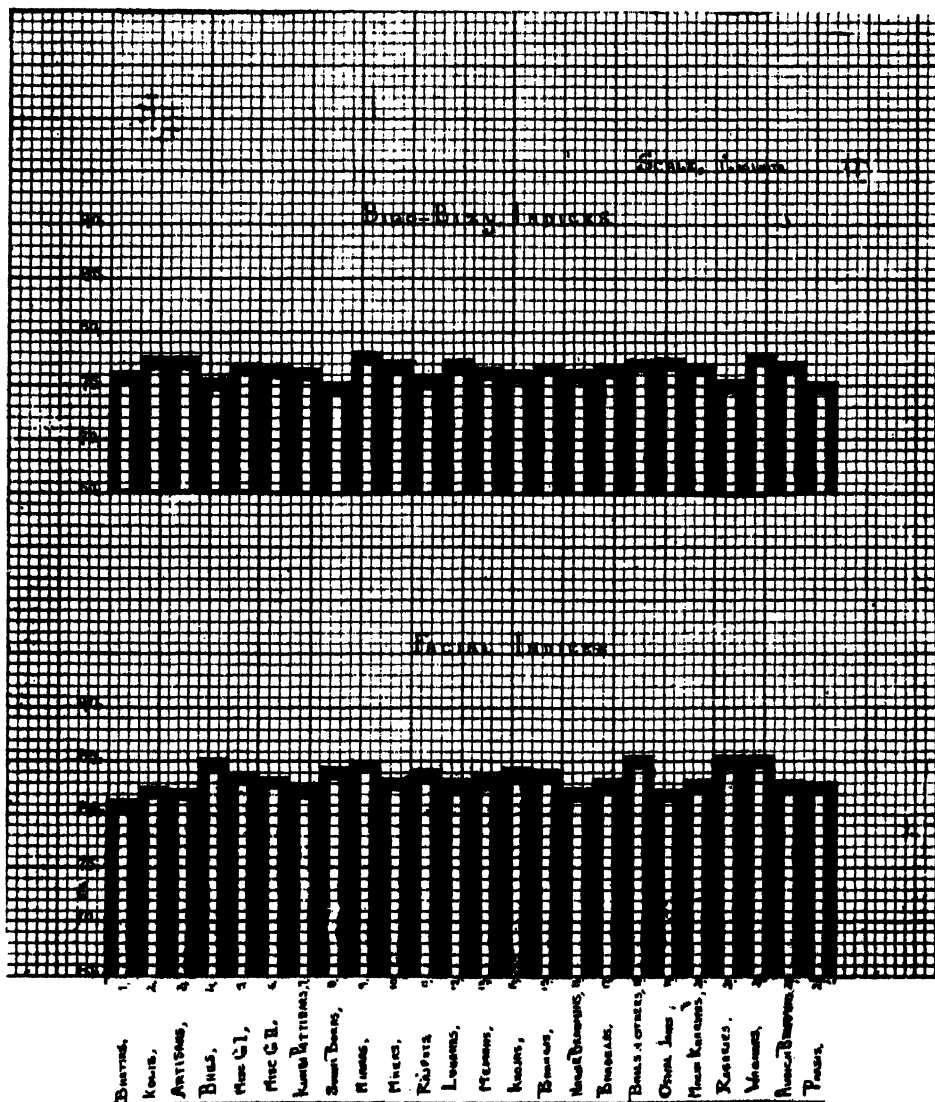


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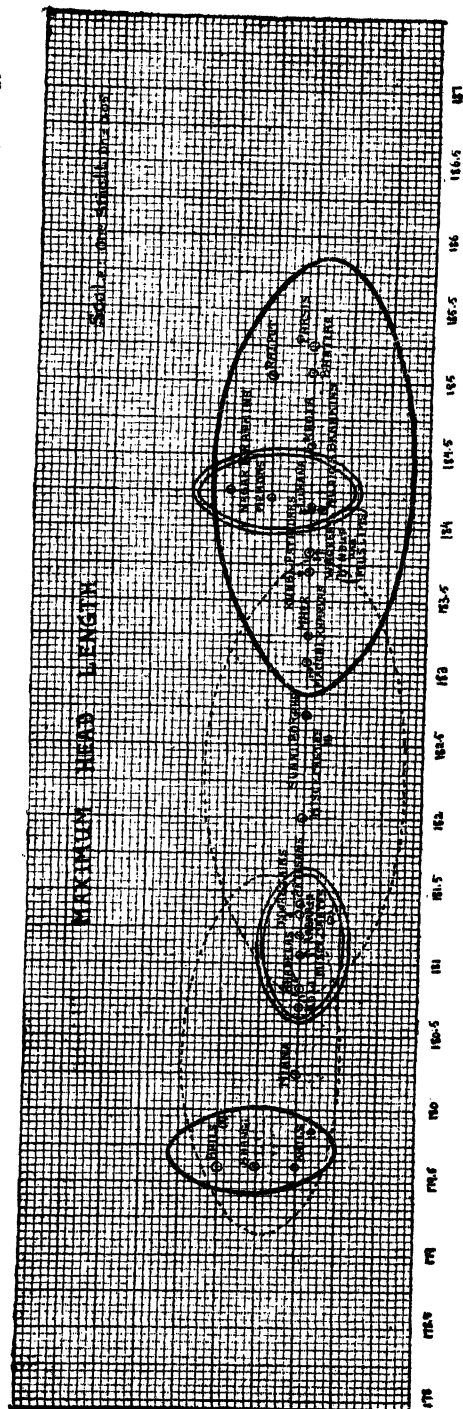
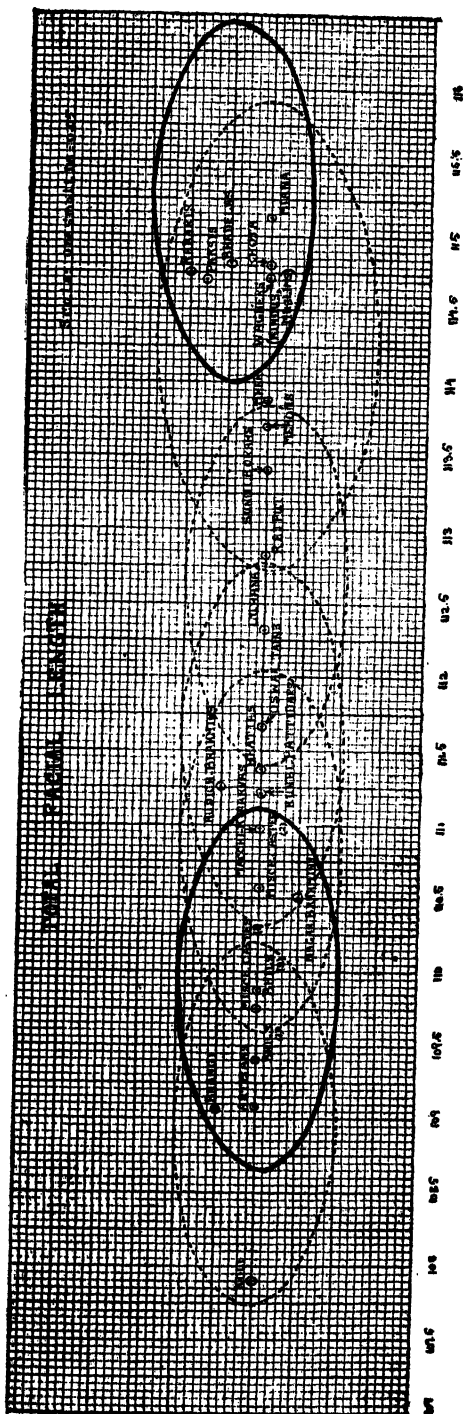
MAP OF WESTERN INDIA SHOWING THE PLACES VISITED AND SOCIAL GROUPS INVESTIGATED.

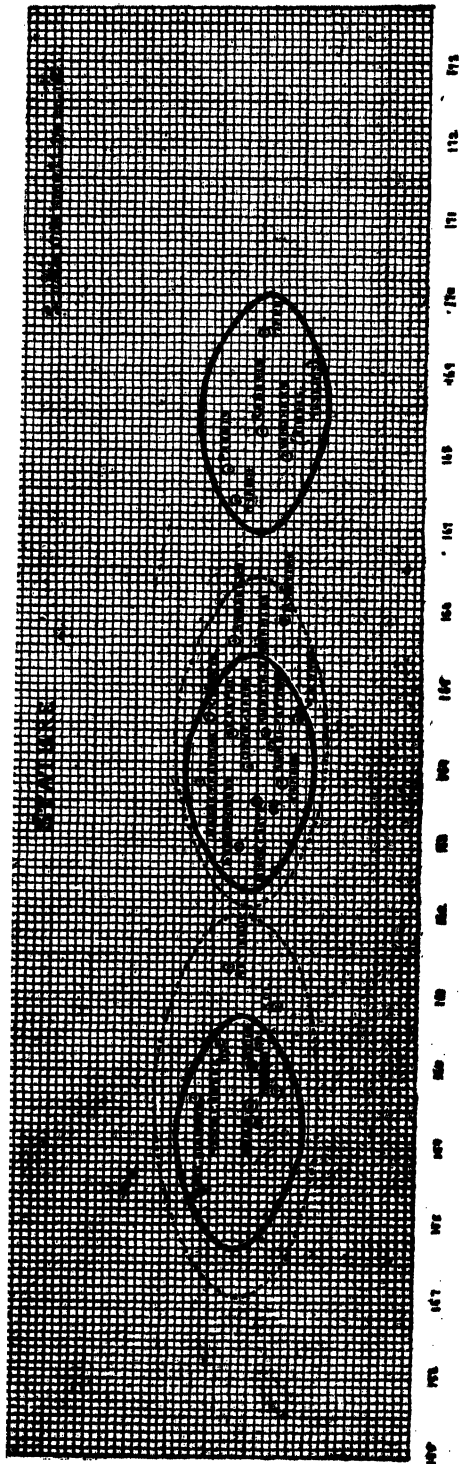
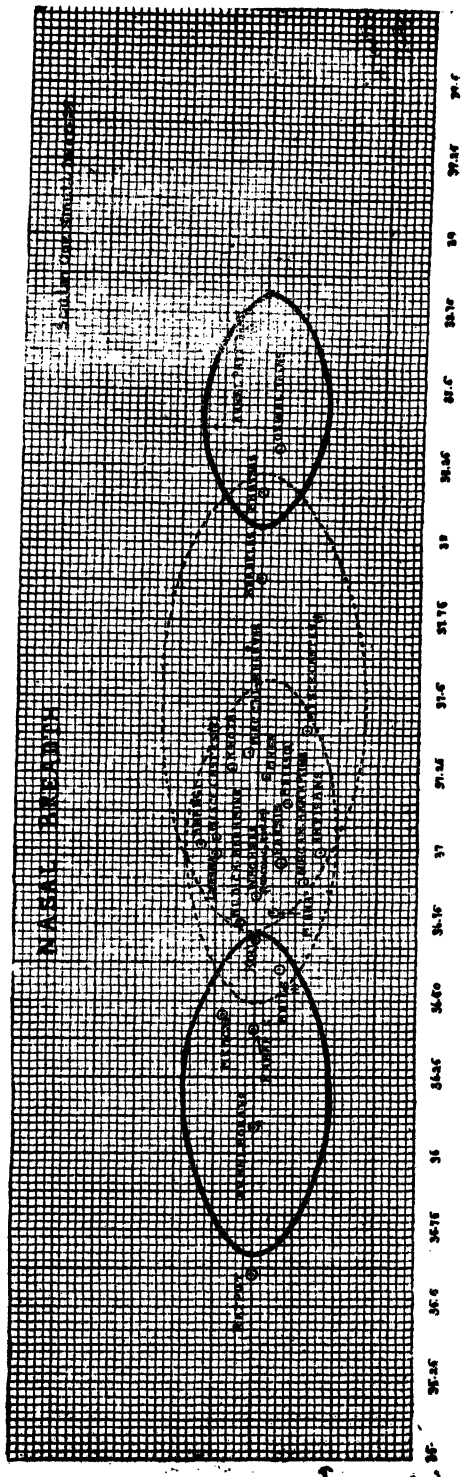


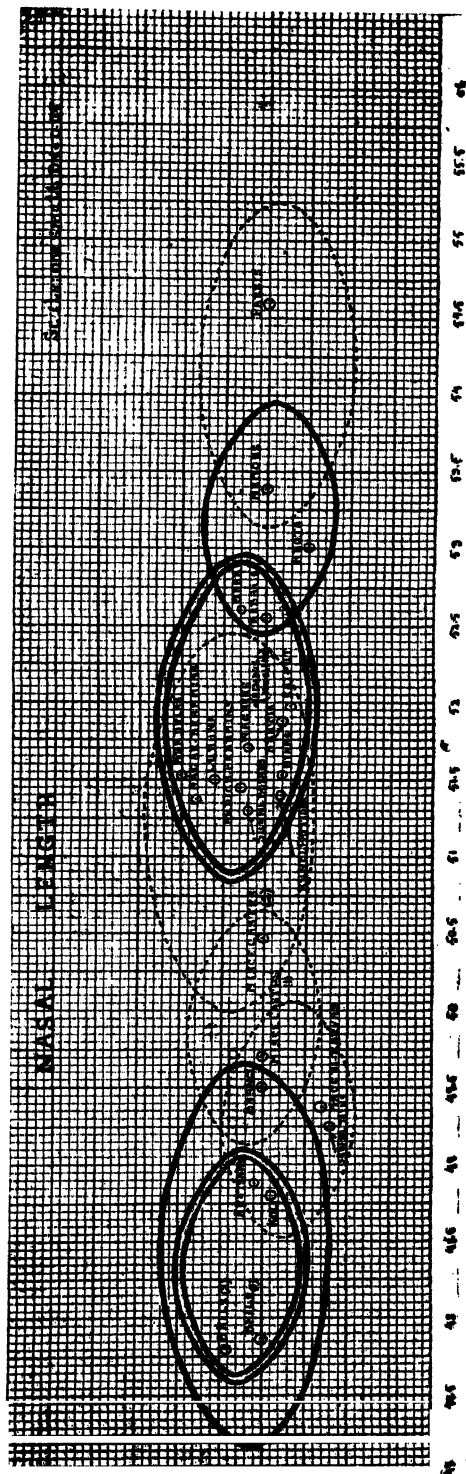
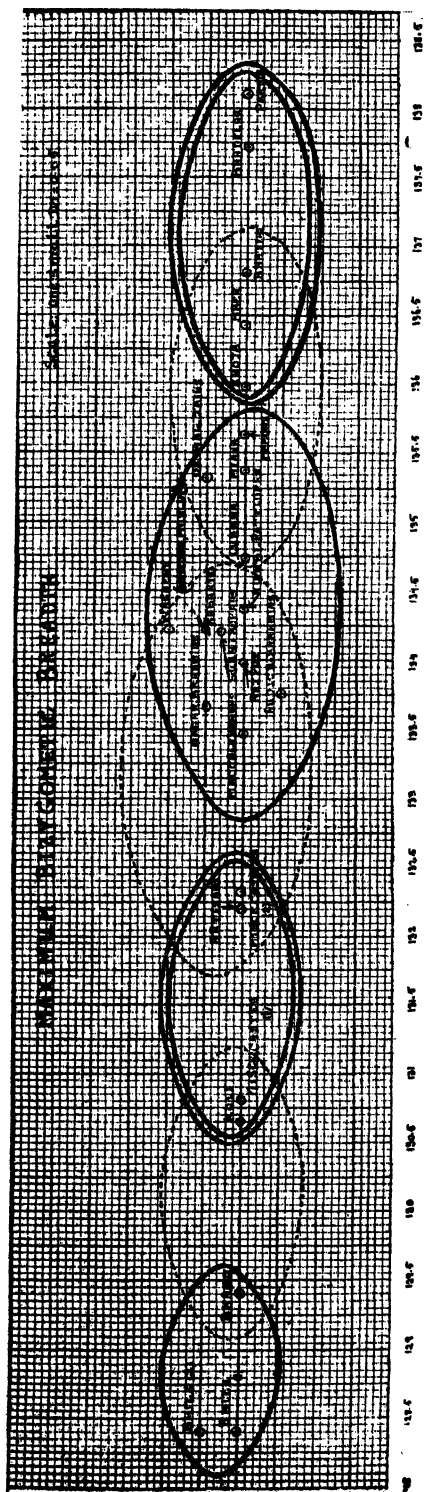


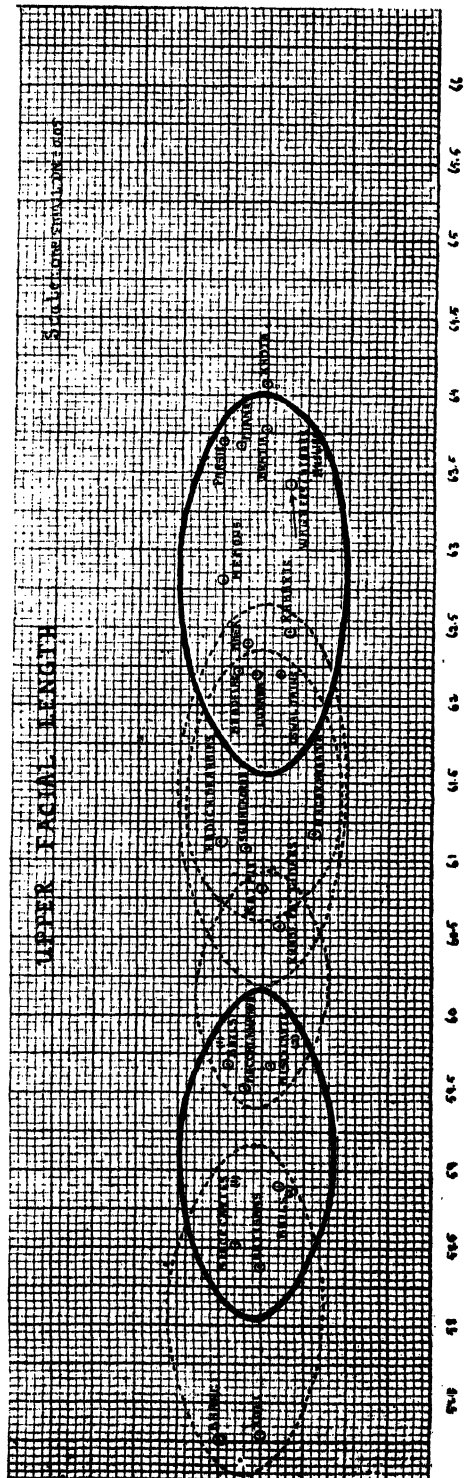
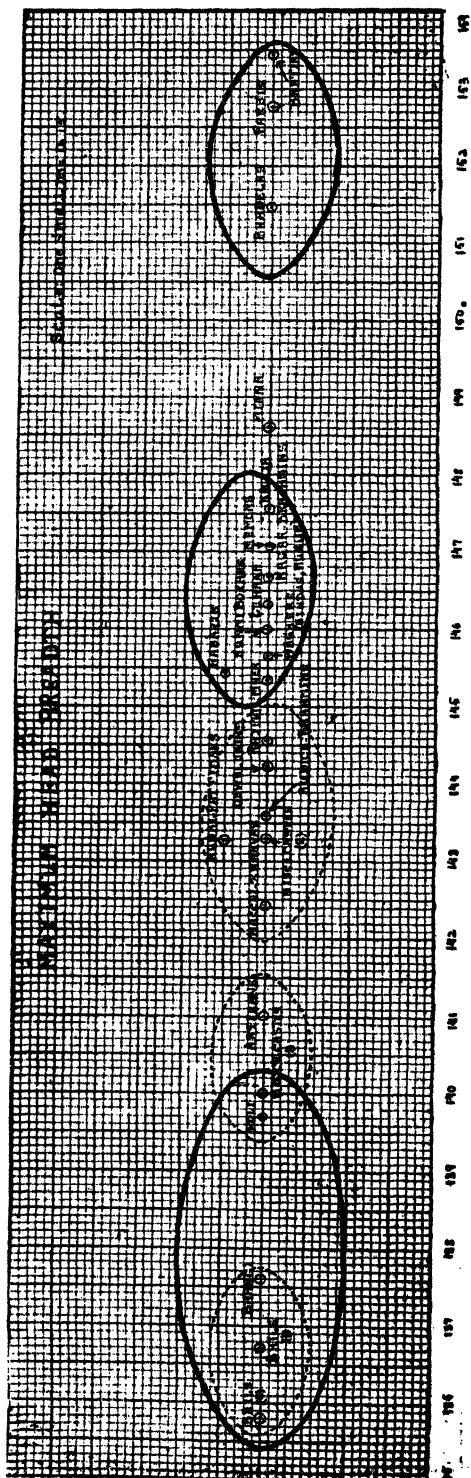


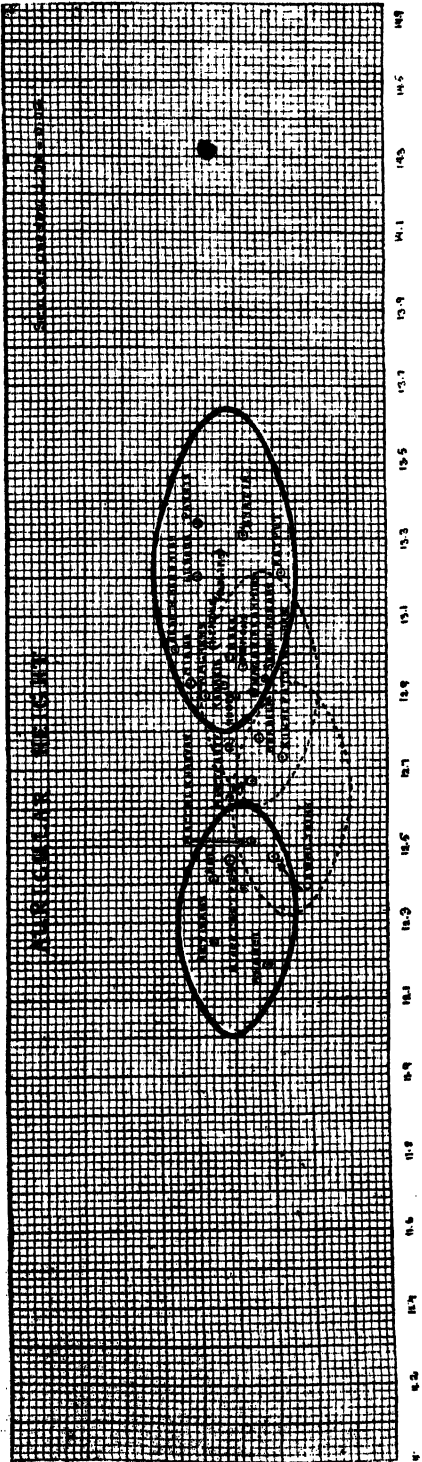
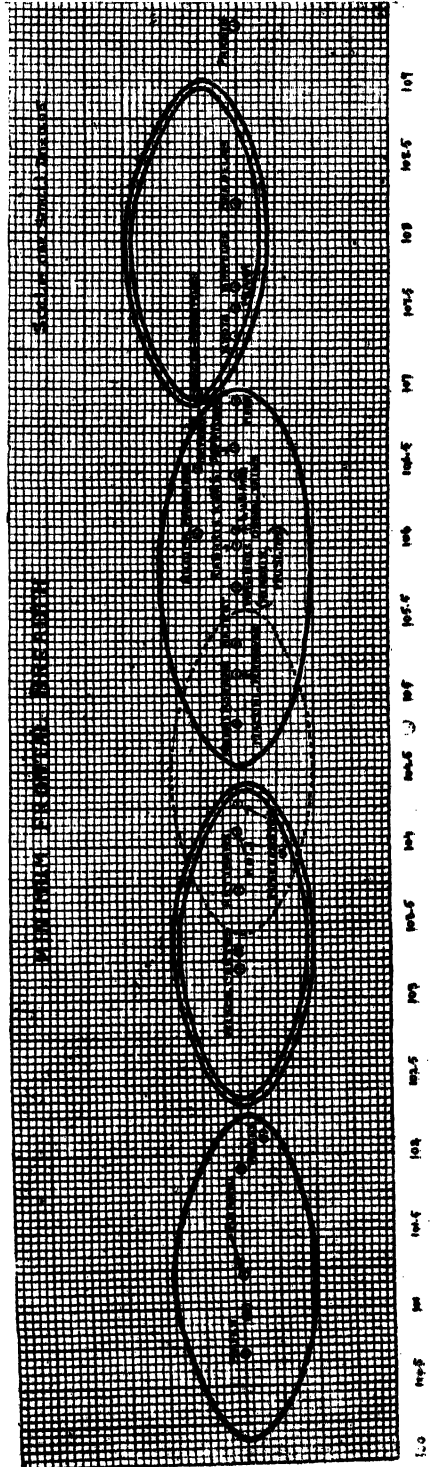
CLUSTERING AND CONSTELLATIONS ON THE BASIS OF INDIVIDUAL CHARACTERS OF CASTES AND TRIBES.

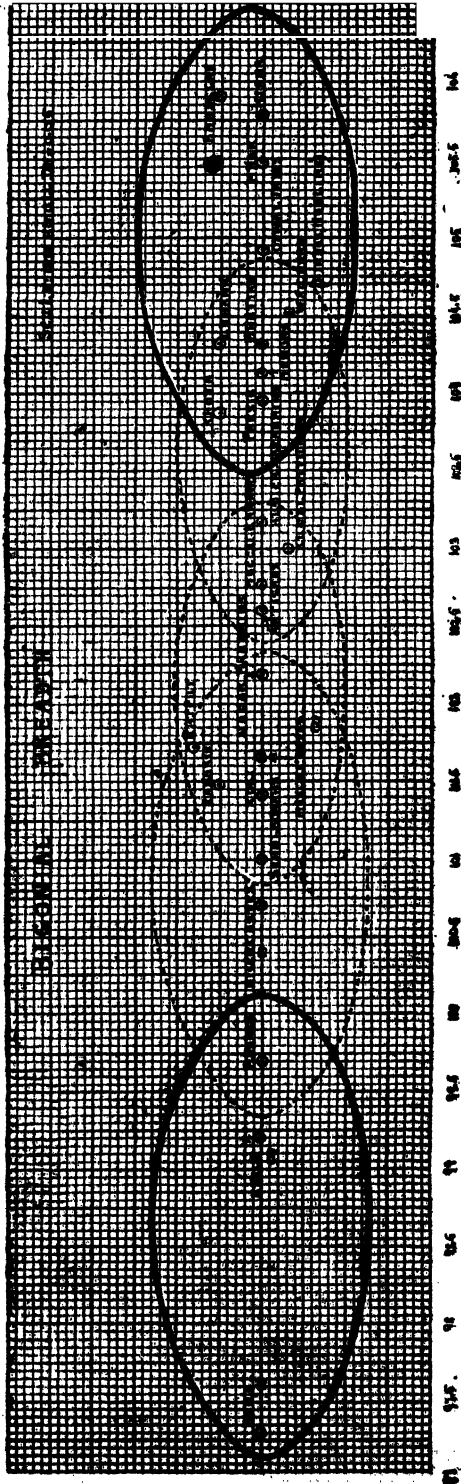
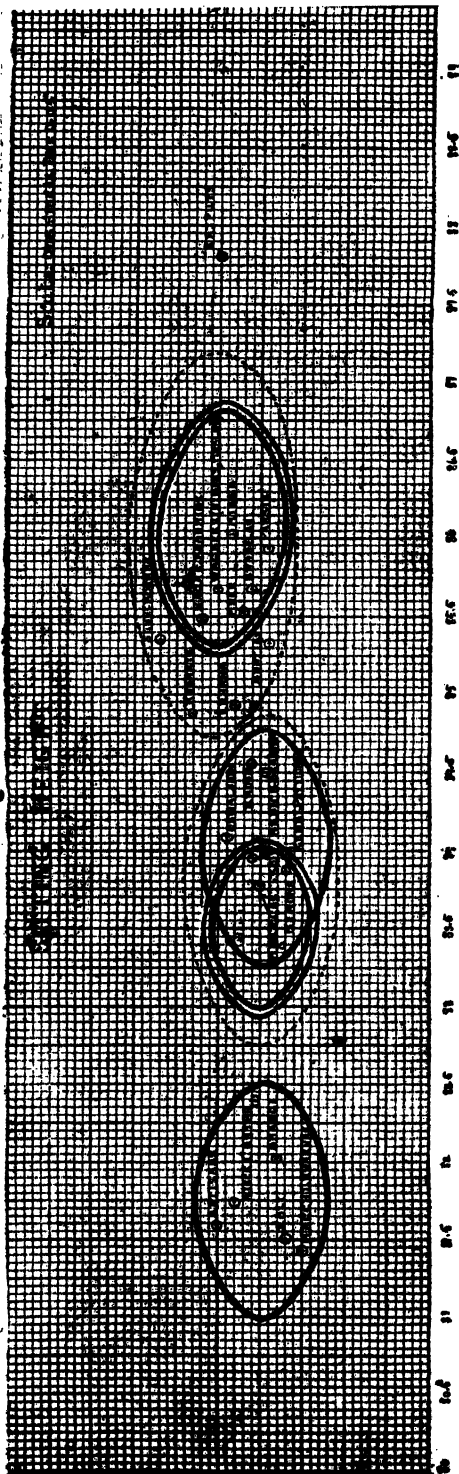












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